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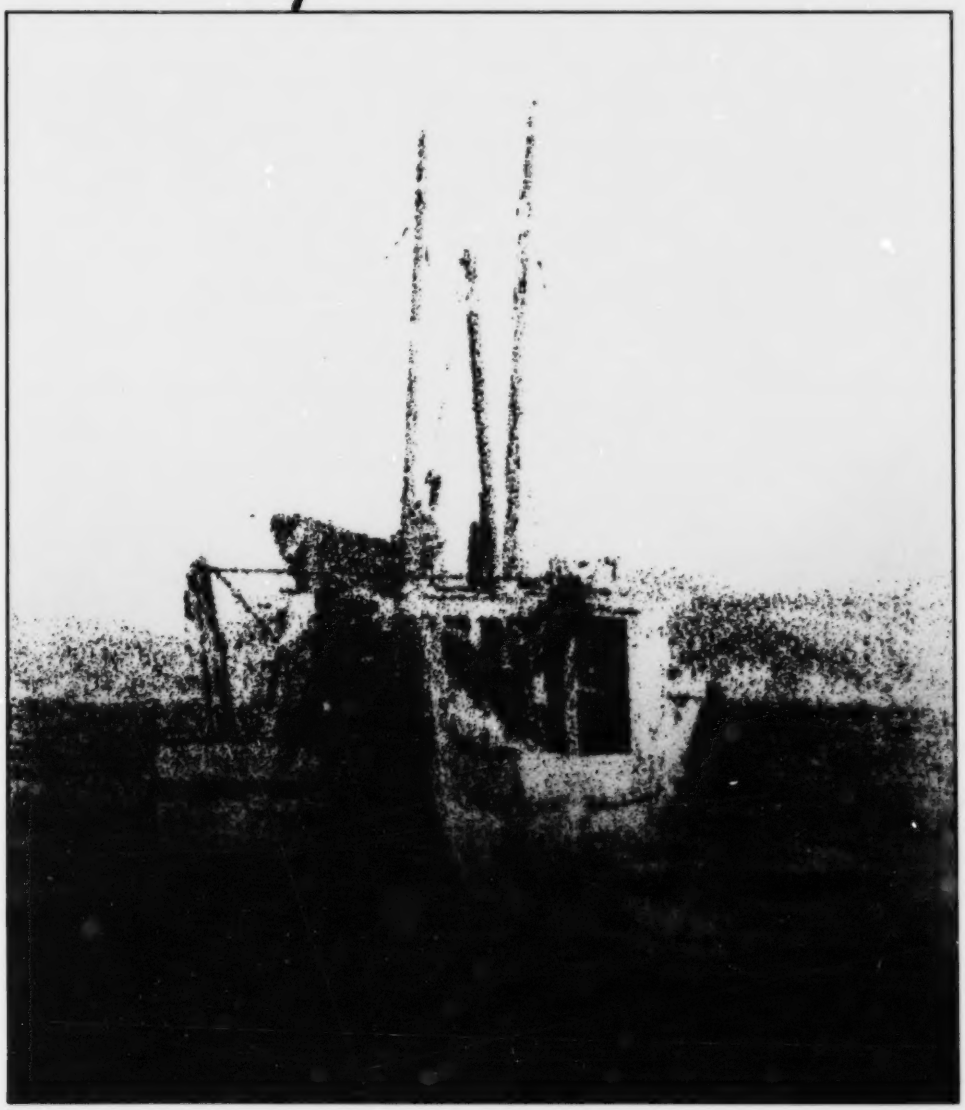
Development 1984-85



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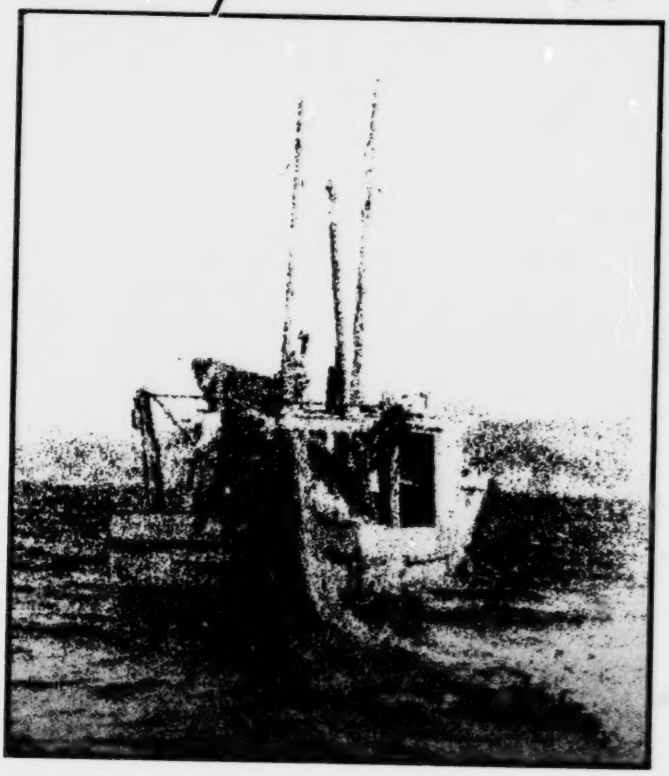
ATLANTIC FISHERIES

Development 1984-85



INTRODUCTION

At the Atlantic Fisheries Technology Conference held in Charlottetown, Prince Edward Island recently, (See Box) a fisheries consultant named Bob Verge issued a challenge to everyone involved with the fishing industry in Atlantic Canada when he said: ''Canada's East Coast fishing industry has simply failed to achieve success – despite opportunities offered by changing consumer lifestyles and eating patterns, despite increased prices paid for fish and fish products, and despite increases in available fish stocks (stocks which are currenty non-under-utilized).''

This report will attempt, without apology, to raise the general level of awareness because, even if the fishery has turned the corner after the recent recession, we are not out of the woods yet!

He told the more than two hundred delegates that the fishing industry has not offered the right products to the marketplace and that it has not been efficient enough. ''*Can there be any doubt about the need for fundamental change*?'' he asked. ''The only real issues to be addressed are the direction of change and the ways in which it can be accomplished''.

Not very subtle perhaps, but very effective – he did what he had to do; he got people's attention!

There can be no denying that, at least to some extent, his observations are valid. However, in the development business, it is the future which is important, and then only in so far as it relates to the

present, *not* the past. Bob Verge, and others, have rightly identified the need to take stock – of where we are and where we are headed with this industry. If we don't like what we see, if we're not satisfied with the direction in which things are headed, we can change, and we should!

ATLANTIC FISHERIES DEVELOPMENT 1984-85 will chronicle the work carried out by the Department of Fisheries and Oceans under its *Fisheries Development Program (AFDP)*, a core function of which is to serve as "*the catalyst for change*" in the industry. This report will attempt, without apology, to raise the general level of awareness because, even if the fishery has turned the corner after the recent recession, we are not out of the woods yet!

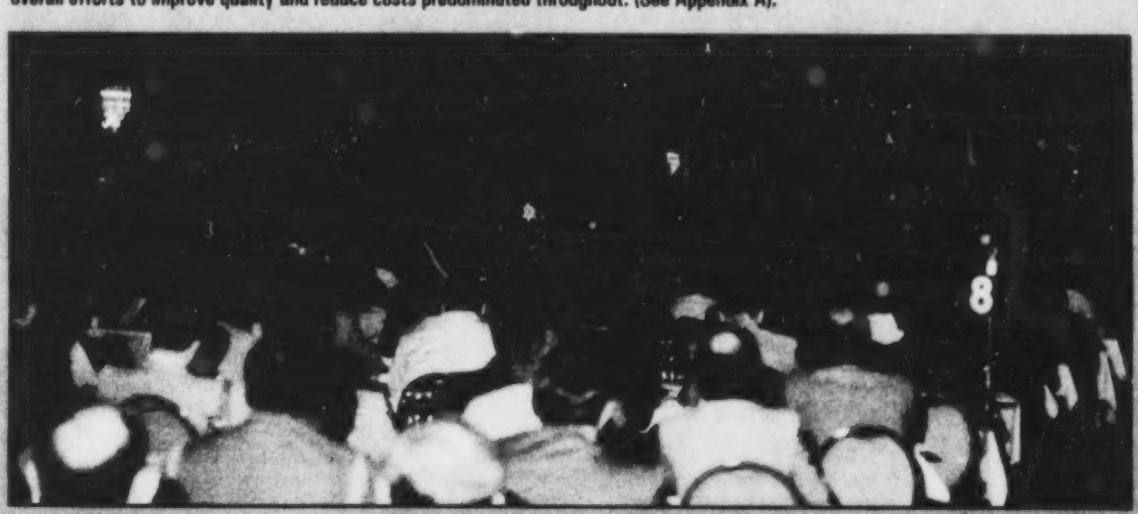
ROBERT W. VERGE
Publisher, The NEWFOUNDLAND Group, St. John's, Newfoundland

"The future of the industry will be only as good as the decisions that are made.

In trying to improve, two related issues must be addressed, – improvement of raw material quality; and the economic and social trade-offs between labour and technology."

The Atlantic Fisheries Technology Conference (AFTC)

The Atlantic Fisheries Technology Conference was held in Charlottetown, Prince Edward Island, April 22-24, 1985. The first conference of its kind held in over ten years, it brought together delegates from the primary and secondary sectors of the industry and from both levels of government, federal and provincial. Speakers from Norway, Denmark, Scotland, England, the United States and, of course, Canada made presentations covering a wide spectrum of current and anticipated technological developments in the fishery worldwide. Three separate working sessions concentrated on fishing gear and equipment, the onboard handling and holding of fish, and in-plant operations, respectively. But scientists and technologists were not the only groups to be heard. Several "non-technical" presentations were made by representatives of both government and the industry. However, the impact of innovative technology on the industry's overall efforts to improve quality and reduce costs predominated throughout. (See Appendix A).



Two hundred delegates – leaders in the fishing industry from the ranks of fishermen, processors, and two levels of government – attended the Atlantic Fisheries Technology Conference. (Above) They were addressed on the opening day of the Conference by New Brunswick inshore fisherman, Donat Le Croix.

The Resource:

Fish stocks and, therefore, catch rates, at least for traditional species, have limited growth potential; they are being fully utilized.

– But *we are not maximizing our return on traditional species* – not catching, processing and marketing the resource in such a way as to reduce costs to a minimum and to command the highest possible prices at each stage of the production-consumption cycle. Then again, too much of the raw material goes unused or to waste/fish meal applications.

– *We have relegated under-utilized species to foreign interests* who possess the energy and ingenuity to harvest a resource we are willing to forego, this at a time when there is growing concern about the overfishing of traditional stocks. Several countries are quite simply not abiding by NAFO* regulations aimed at protecting cod on "the nose and tail of the Bank", just outside Canada's 200-mile limit.

– And *non-utilized species we leave "in the water", an untapped potential*. This has traditionally been the case because they are difficult to catch and/or there has been no demand for them. But, with our level of technical expertise and a little imagination, there is simply no reason for this to continue.

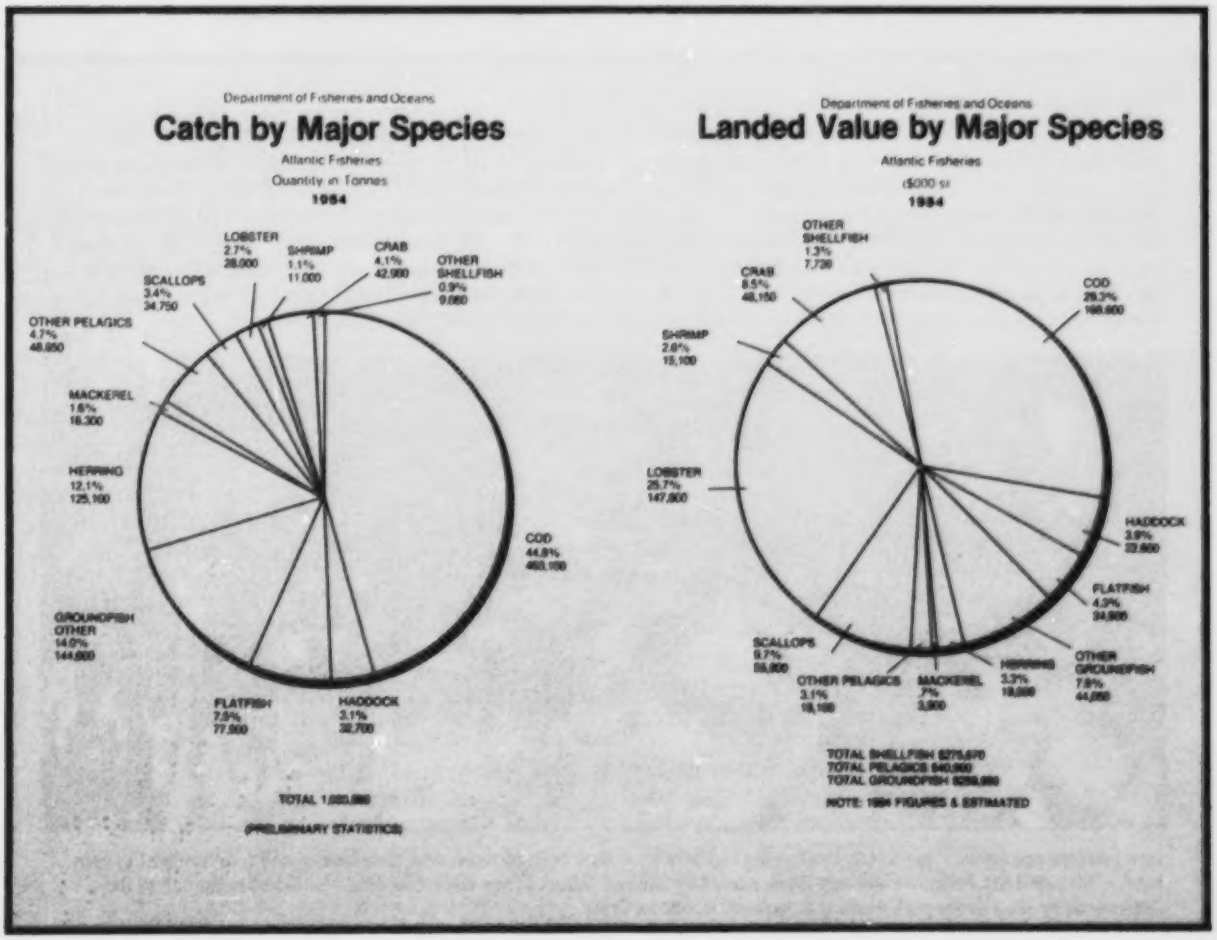
The Industry:

Higher-quality, higher-value output at lower cost is the only viable strategy for the future.

We are being out-competed in the marketplace, playing catch-up. Our competitors have the reputation; they command the premium prices. *Consumer tastes and expectations have changed*; our standards have not changed as readily in terms of quality, texture, consistency or value. *We are only now beginning to capitalize on the opportunity these changes represent*.

Some observers feel *the industry is tradition-bound and lethargic, "ten years behind the times"*. While this may be changing, the perception lingers.

*Northwest Atlantic Fisheries Organization



The east coast fishery still has a quantity orientation and still is *"a house divided"* (witness the Nova Scotia/Newfoundland factory freezer trawler debate and the recent haggling over quotas between the inshore and offshore sectors in Nova Scotia).

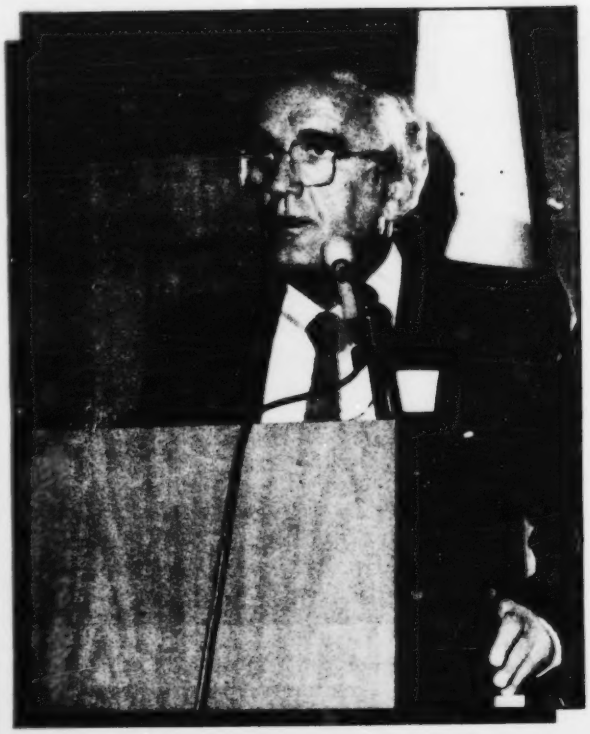
Inshore Fishery

The INSHORE FISHERY is *extremely vulnerable to environmental conditions*, especially where fishermen depend on one species. Newfoundland, for example, experienced the almost total collapse of its inshore fishery when cold water temperatures resulted in groundfish not "striking in to shore" during the 1985 season. In some locations, this fishery employs out-of-date technology and an inappropriate scale of operations (created to cope with a peak-season "glut" in the supply of fish). Considered by some to be a technological and economic anachronism, it nevertheless embodies social considerations of considerable proportion which, if they cannot be resolved, must at least be accommodated.

In sharp contrast would be the inshore fishery in southwestern Nova Scotia. Fishermen there have diversified their operations among several different species, while their close proximity to U.S. markets virtually assures a steady demand for their products and a built-in logistical advantage. Even there, however, with reductions in the total allowable catch (TAC) of some groundfish species, the need for greater efficiency of operations (quality product, reduced costs, and new technology) has become a constant necessity.

Overall, the inshore fishery may no longer be able to sustain all of the people and communities that cling to it for survival. To quote the former federal Deputy Minister of Fisheries and Oceans, Dr Art May[1], "The numbers that are dependent on the fishery both ashore and in the boats are too great; the fishery simply cannot carry all of those people and all of that invested capital."

1. In a television interview with Barbara Frum on CBC's "The Journal."



JACK GRAHAM
Chief, Engineering Section, Torry Research Station Ministry of Agriculture, Fisheries and Food, Aberdeen, Scotland

"I now realize that our new technology and yours are not quite at the same level. I would have to go back 10 years to find situations in the U.K. which would resemble what is taking place in Canada right now."

Offshore Fishery

The OFFSHORE FISHERY, having been restructured, is being "re-restructured", (at least in Newfoundland). The sector has *excess capacity in "dated" assets* (vessels, fish plants and equipment). The consensus seems to be that it must become, to again quote Dr. May "A bit leaner and a bit meaner". Two large fleets of vessels in Atlantic Canada will have to be replaced and rationalized within 5 to 10 years. Tough decisions will have to be taken regarding processing plants which are out of date, inefficient, too labor intensive and, therefore, no longer viable. This is occurring at a time when the profit scenario has just turned the corner from "dismal" to "marginally improved". This sector, too, suffers from mild socio-economic schizophrenia, attempting a delicate balancing act between profit and social responsibility. The potential for improved efficiency inherent in the recent introduction of factory freezer trawlers, for example, may yet be held to question in light of the social implications involved with the use of such technology.

Fish: nature's brain food
Eating fish linked to healthy heart
FISH - THE PERFECT CHOICE FOR TODAY'S LIFESTYLE
IT'S TRUE: EAT FISH OFTEN AND

It is difficult to remain unduly pessimistic in light of such a positive "press". Potential exists; opportunity beckons; if only . . .

The optimists proclaim that we have turned the corner. Positive signs were indeed evident in 1985. But a number of definite problems exist and must be overcome if the emerging positive trend is to continue into 1986 and beyond. This Report will detail some of what has been done; it will discuss much of what must yet be done to sustain the progress we have made. 1986 will be a critical year and, for better or for worse, could establish our course for the remainder of the decade.

What is needed is "an industry vision", a widespread consensus on what the industry must become. Ideally, the Atlantic Fisheries Development Program should help establish that consensus; it should help establish a sense of direction for all participants.

As Glenn Etchegary, one of that new "breed" of managers entering the fishing industry, has said

The Need for Change

The news is not all bad! After serious difficulties during most of this decade, the industry now seems to be on the verge of better things. Even the Newfoundland fishery, according to many observers, seems to have bottomed out and to be ready for a turnaround. A devalued Canadian dollar, improved demand, and supply problems on the part of some of our key competitors saw markets improve, in general, for Canadian fish products in 1985. In Atlantic Canada, however, the success may be short-lived. The competitiveness of fish products from Eastern Canada on U.S. markets has brought charges of unfair trade practices and, for now, "temporary" countervailing duties. Increasingly, there is the danger that these will become permanent.

Glen Etchegary, Vice President, Harvesting, Fishery Products International Ltd.; St. John's, Newfoundland

"In general, there are two factors that will secure our future: -- our ability to effectively compete in an extremely competitive marketplace, through the marketing of high quality products that will stimulate consumer demand; and, improvements in cost efficiencies, to allow our products to be sold at competitive prices."

(at the AFTC), two factors will secure our future – high quality products that will stimulate consumer demand and improved efficiency which will permit competitive pricing. That simple nostrum – to compete – is down to earth; the challenge lies in making it happen. Meeting this challenge is what the Atlantic Fisheries Development Program is all about.

We will need vision, a commitment to change, and a plan of action. ***Someone must fire the imagination, must help create a vision of what is possible***. This is the missing, almost magical ingredient in any strategy for the future of the East Coast fishing industry. We have the resource; we have the markets; we have the technical expertise (at least potentially). What appears to be lacking is the imagination and the will. ***AFDP can help provide the vision; the industry must provide the will!***

There are important lessons to be learned from what has happened elsewhere in the world. In the United Kingdom, for example, change did not come easily. Dr. Francis Clark, President of Clipper Seafoods, Aberdeen, Scotland told AFTC delegates "Those who harness change to their advantage have an opportunity to strengthen their positions; those who ignore the need to change, don't survive." This we should not have to learn the hard way. Dr. May reinforced the point when he warned the industry to face up to changing circumstances. "In this or any other industry, overcapacity, poor quality control, and failure to apply new technology, combined with marketing weaknesses, all carry a price", he said. Central to the failure to manage technology, of course, is concern regarding employment. But Dr. May argued correctly that "We face a problem of adjustment, not an overall loss of jobs".

Dr. Francis Clark, President, Clipper Seafoods Ltd., Aberdeen, Scotland

"If . . . governments have any role to play in assisting industry . . . the advancement of new technology is the place to begin."

We have had a change in technology and we're seeing a generational change in management. This brings into question the very role of government. A new definition of that role, as it effects the fishery, was provided at the AFTC by Mel Gass, Parliamentary Secretary to the Minister of Fisheries and Oceans, who said "When government tries to push technology unto an industry, it's like pushing on a chain. To make it work, industry must pull on the other end. In future, the Department of Fisheries and Oceans (DFO) will base its development work on the industry's lead". The objective . . . people-oriented, profit-oriented technology. ***The vision . . . a modern, competitive, world-class fishing industry***. We are entering a new era and this is how things must be!

The AFDP Mandate

The Royal Commission of the Economy, headed by Donald MacDonald, observed that change is "extraordinarily difficult to achieve (in the fishing industry) because it has become inextricably bound up with regional development, employment policy and a profound desire to preserve lifestyles and communities". The real issue, as far as the Commission was concerned, is whether Canadians are prepared to apply "the discipline required to facilitate adjustment and to attain the longer term benefits" the fishery can provide.

All discipline begins with a plan! A plan begins with objectives. In 1984-85, the AFDP has had four:

1. To Expand and Diversify the Commercially Harvestable Resource Base.
2. To Reduce the Cost of Harvesting, Processing, Handling and Storage of Fish and Fish Products.
3. To Enhance the Value of the Commercially Harvestable Resource through Quality Improvement and Product Development Initiatives.
4. To Increase the Utilization of Conservation-Oriented Harvesting Methods and Technology.

The problem with objectives is that they can engender a certain degree of skepticism . . . at least in some quarters.

People, quite rightly, demand to know: Is this the RIGHT way to proceed? To get to where you're going, you have to know where you want to be. Objectives point the way; they let you know where you stand at any point in the process. These objectives were arrived at through consensus-building over time involving DFO and "the client" (both fishermen and processors). Consultation, communication, and technology transfer activities all played a role (the Atlantic Fisheries Technology Conference itself is a good example). Increasingly, industry-wide, there is emerging an understanding that ideally, objectives must translate into meaningful activity, activity that places us where we want to be with the fishery.

The functions which lie at the core of AFDB activity are:

- to identify and define the major problems and opportunities confronting the fishery;
- to help develop an awareness in the minds of participants of the threat and/or challenge they represent;

Objectives — *Atlantic Fisheries Technology Program*

DEFINITIONS

1. To Expand and Diversify the Commercially Harvestable Resource Base.

to provide the broadest economically viable and biologically sustainable resource to serve as a basis of employment in Atlantic Canada.

2. To Reduce the Cost of Harvesting, Processing, Handling and Storage of Fish and Fish Products.

to minimize costs in order to increase incomes to those who derive their livelihood or who benefit in other ways from the fisheries.

3. To Enhance the Value of the Commercially Harvestable Resource through Quality Improvement and Product Development Initiatives.

to maximize revenue at each stage of the production-consumption cycle to ensure that innovative, diversified products of consistently high quality are available to effectively meet market demand.

4. To Increase the Utilization of Conservation-Oriented Harvesting Methods and Technology.

to introduce and improve harvesting techniques which will reduce by-catch and mortality ratios, thereby enabling the industry to better target and maximize its catch within the approved resource management framework, and to promote the dispersion of fishing effort among species and gear types to ensure that incomes are maximized and stabilized over time.

Fisheries development, especially when it takes the form of technological change, is not without its critics. Even when couched in humor, criticism must be addressed in some positive way. At its most effective, this response will take the form of action. The AFDP must stand on its record!

Courtesy of the Eastern Graphic, Montague, P.E.I.

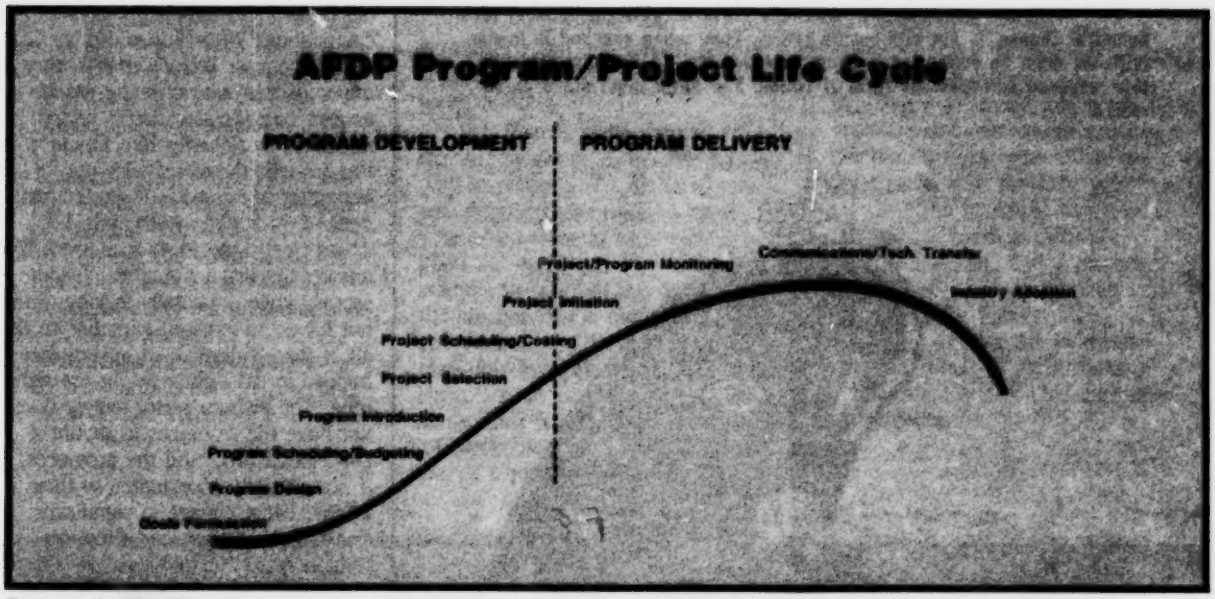
– to explore alternative approaches to dealing with the situation thus defined;
– to initiate work aimed at exploiting the opportunities and finding solutions to the problems;
– to communicate the results of this work to "the client" – fishermen and processors; and
– to develop, in cooperation with industry, a strategy of implementation.

But when planning and analysis, research and development, and technology transfer work has been completed, much remains to be done. To the extent that all of this in itself is not enough, bolstering it with "Special Programs" which provide infrastructure, incentive programs, financial assistance, etc. is often required. In fact, experience has shown that it is an absolute necessity! ***Change requires that certain pre-conditions be met***. To quote one AFDP manager, "There's alot of work that has to be done 'up front' so that a process of change can develop. It is essential that basic infrastructure be provided to make it possible for the kind of evolution we are talking about to take place". ***Special Programs***, then, ***are at times pre-conditions for evolution***. (We'll have more to say about them in a later section). But striking the balance between how much is enough for government to be doing and how much is too much is what is required.

One thing is certain though – if government does too little or nothing at all to develop the fishery, we will fall further and further behind the competition. We will lose out by default because literally *every other major fishing nation in the world invests considerable public sector resources in fisheries development*. We are left, therefore, with two important questions – if government doesn't do it, who will? and, if it doesn't get done, does it matter? To answer the first point, the offshore sector, while not totally lacking, does not have the required expertise to do all of these things or to ensure they happen in the right way, at the right time. The inshore sector simply does not have the resources to mount a concerted effort. And the provinces, if not centrally coordinated in their efforts, could engage in significant duplication of effort and thus, at best, achieve "mixed results." On the second point, if government can't continue to take complete responsibility for fisheries development, the private sector will simply have to assume more of the burden. If it were to fail to do so, the result, and we might as well face it, could well be major crisis, major socio-economic upheaval! The message is clear – fisheries development is a joint responsibility.

AFDP has therefore undertaken "to push on the chain" to the extent that the industry will pull on the other end. The problems and opportunities are known; a strategy is in place; work is being done on the techniques and technologies to help us reach our goals; and we are engaged in the ongoing process of putting in place the required infrastructure . . . all of which brings us to "evaluation". Evaluation "closes the loop" on all of this activity.

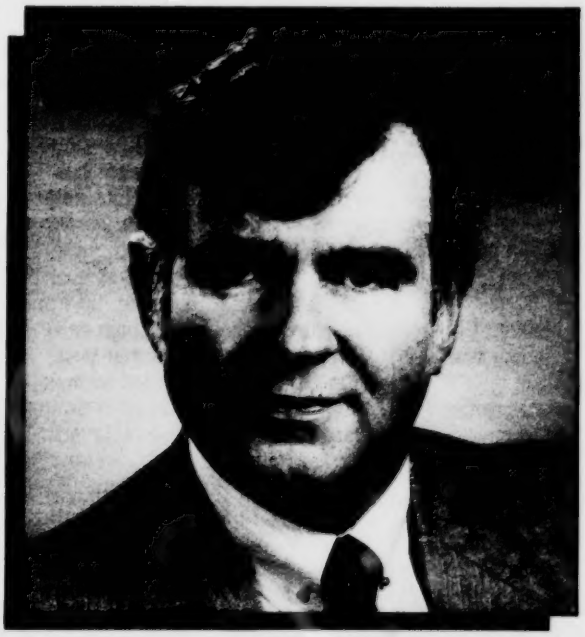
AFDP managers feel that their work must be judged on the broadest possible basis, on whether or not it has brought about fundamental change, whether they have created a proper environment and



Between the identification/assessment of options stage and the program evaluation stage lie a whole series of activities best understood as Program Project Management. These day-to-day activities by AFDP are intended to result in industry acceptance/adoption of results achieved.

whether or not the necessary incentives are in place to ensure that fundamental, evolutionary change occurs. Rather than evaluating the success or failure of a particular project, they feel the Program must be evaluated in terms of how far any given activity moves us towards achieving our objectives. All that matters is whether the pieces come together: whether the proper dynamics have been put in motion; whether they have been reinforced at the appropriate stages; and whether there have been concrete results. The job is to map out an overall strategy and then, very selectively, decide where and to what extent to get involved; the art of fisheries development is to choose those points and optimize the allocation of resources so that there is an impact.

The AFDP is part of just such a process. The remainder of this Report will discuss the progress that is being made.



R.W. Bulmer, President. Fisheries Council of Canada, Ottawa, Ontario

"Applying high technology to the fishing industry is expensive and time consuming. Canada lags behind in this area considering the volume of fish we sell.... DFO is long on bioligists and economists; it is short on engineers.... Few, if any, processors are big enough to tackle the application of technolgy to the fishery."

REGIONAL HEADQUARTERS

1. Halifax
2. Memramcook (Moncton)
3. St. John's
4. Quebec City

SCOTIA-FUNDY

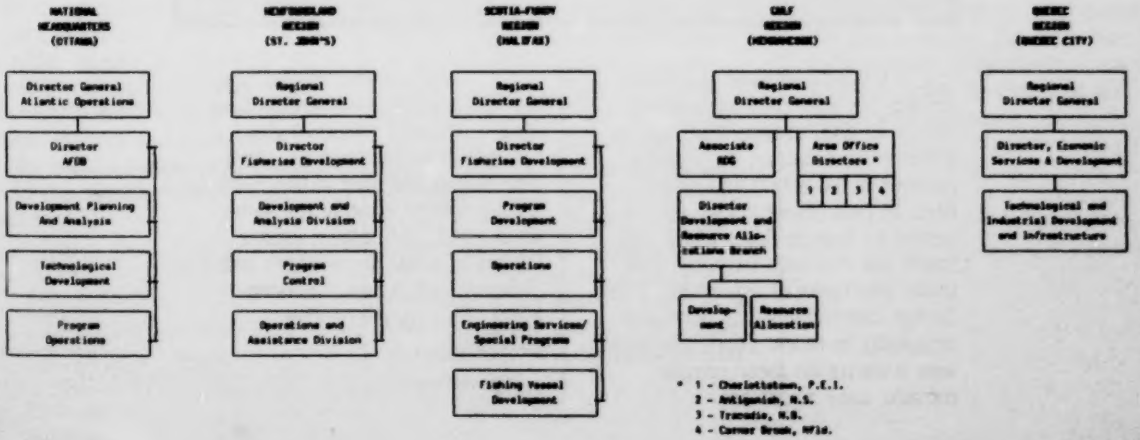
NEWFOUNDLAND

GULF

QUEBEC

Organizational structure is also part of the recipe for success. The AFDP is de-centralized and, regionally, is administered by four very different units. N.H.Q. (Ottawa) co-ordinates among Regions, among the five eastern provinces and with other departments of government on an Atlantic-wide basis. Overall responsibility for planning, coordination and review of the Atlantic Fisheries Development Program rests with its Directors' Committee. (See Appendix B)

ORGANIZATIONAL STRUCTURE OF A.F.D.P. "BRANCHES" IN ATLANTIC CANADA



THE RESOURCE BASE

Objective: To Expand and Diversify the Commercially Harvestable Resource Base–

to provide the broadest economically viable and biologically sustainable resource to serve as a basis of employment in Atlantic Canada.

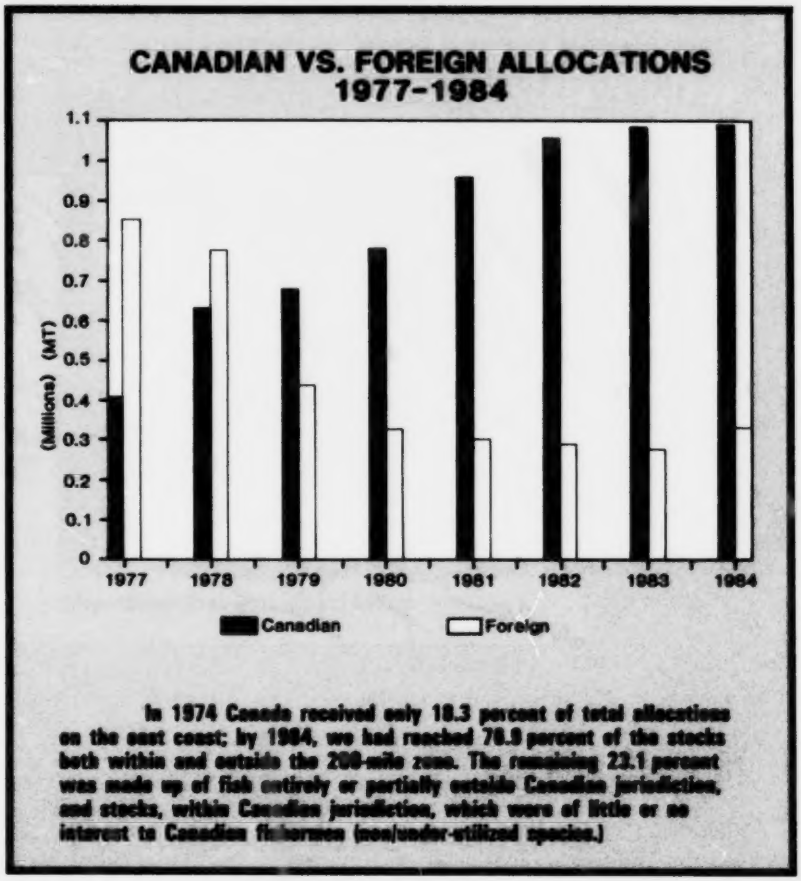
Stocks of most traditional species are now fully exploited or nearly so and, in fact, may not be sufficient to maintain the existing number of fishermen and size of fleet. In part, these stocks are harvested by foreign fleets which fish inside our 200-mile territorial limit under international agreement. While foreign involvement has decreased drastically in recent years, the pressure it exerts on these species remains quite significant.

The Minister of Fisheries and Oceans, the Honourable Tom Siddon, recently observed that groundfish available to the Canadian fishing industry in the 1986 season will be roughly the same as in 1985, one million tonnes. However, while some TAC's will increase (turbot and American plaice, for example), other groundfish

stocks, notably cod and haddock on the Scotian Shelf and cod in the Gulf of St. Lawrence, will decline in 1986.

Furthermore, it is generally agreed that we are not maximizing our economic return on these resources and that we are not developing and/or exploiting the potential which exists in an evolving marketplace for new or modified products. Fish sold in frozen blocks, which might have been sold as fillets; fish of inconsistent quality (texture) reaching market, which, with a little extra care and attention, might have commanded a "premium" price, represent revenue which was ours for the taking, gone forever. It is estimated that this loss of revenue amounts to as much as $50 million a year in Atlantic Canada and that it is increasing annually.

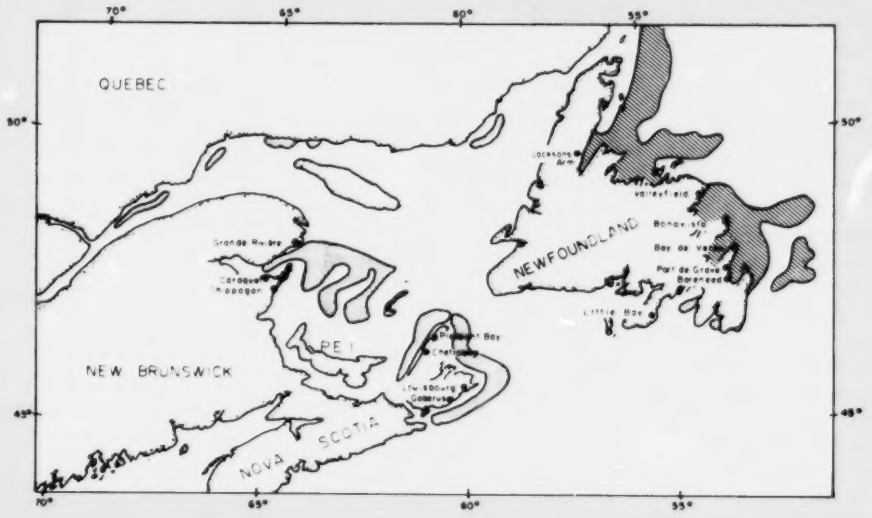
Non/Underutilized-species, we either leave in the water or, worse, allow to be exploited by foreign fleets. While this has been necessary in order to gain access to foreign markets, it is a strategy which, in part, comes back to haunt us. While Canada remains the world's leading exporter of fish, we import almost half as much (in dollar terms) as we export. There are reasons, of course, why we do not fully exploit every species: with some, we lack fishing and/or processing expertise; for certain species market demand is weak; etc. Squid, mackerel, male caplin, dogfish, redfish, silver hake, grandier, tuna, and certain shellfish, among others, fall in this category. Resource surveys to establish which species are available in commercial quantity, in what areas, and the best methods and means to harvest, process and market them can yet make an important contribution to the overall viability of the industry.



In 1974 Canada received only 18.3 percent of total allocations on the east coast; by 1984, we had reached 76.9 percent of the stocks both within and outside the 200-mile zone. The remaining 23.1 percent was made up of fish entirely or partially outside Canadian jurisdiction, and stocks, within Canadian jurisdiction, which were of little or no interest to Canadian fishermen (non/under-utilized species.)

Then, too, there is aquaculture, an underdeveloped aspect of bio-technology. The potential exists to "sea ranch", to enhance natural stocks and to let them live in the wild until their eventual harvest, and to "farm" finfish and shellfish, to keep them in holding impoundments of various types, to be cultural, sheltered and fed to maturity. Salmon, mussels and oysters are typical species. Aquaculture research into reproduction methods, hatchery systems, feed formulation, disease control and systems management will, however, become increasingly important in the years to come as we take our rightful place in the industry alongside the Chinese, Japanese and Scandinavians.

The Atlantic Fisheries Development Program includes a substantial body of work designed to enable the east coast fishing industry to diversify and to better utilize the resources available to it. In meeting this first objective, the work has three primary components – resource surveys, surimi development and aquaculture projects.



The Atlantic Snow Crab

The commercial fishery for snow crab on the Atlantic began in 1967 after exploratory surveys had located abundant stocks in the Gulf of St. Lawrence. Since then, new stocks have been located almost every year. In 1967, a total of 616 tons (t) were caught in the Gulf waters. Since then, annual landings reported in the Gulf have been increasing steadily to reach a peak of roughly 18 000 t in 1979.

Snow crab are common in the estuary and the Gulf of St. Lawrence around Cape Breton Island and in the bays of Newfoundland, from Fortune Bay to White Bay. They are also found near Hamilton Bank off Labrador.

Snow crab live most commonly on muddy or sand-mud bottoms at temperatures ranging from −0.5 to 4.5°C. In the Gulf of St. Lawrence, they are usually found at depths of 70 to 140 m, while in Cape Breton the depth varies from 45 to 245 m, and from 170 to 380 m off Newfoundland. The distribution of small crab is not well documented but they are occasionally found with the adults, or on gravelly bottoms at shallower depths. In some areas, there are indications that snow crab move from gravel bottom to mud bottom, usually in deeper waters, as they reach maturity.

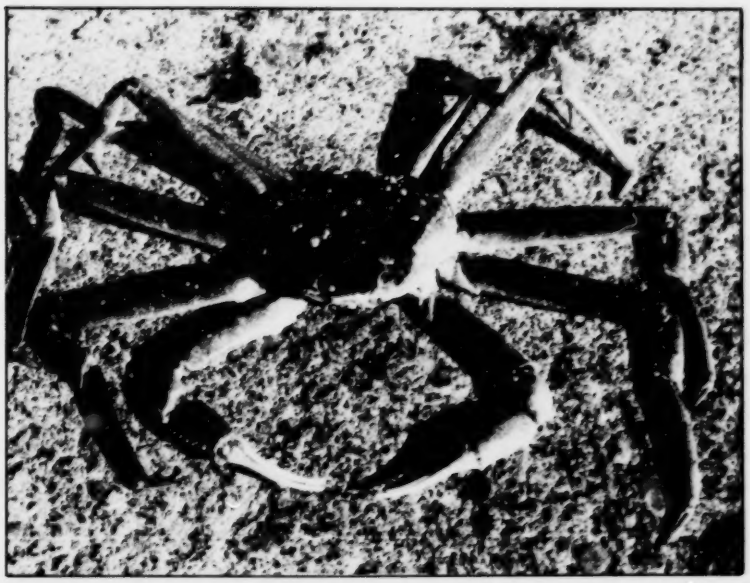
The main fishing grounds in the Gulf are located between Gaspé Peninsula and the Magdalen Islands, and around Cape Breton Island. The main ports of landings are Caraquet, Shippegan and Lamèque in New Brunswick; Grande-Rivière and Ste-Thérèse in Québec; and Pleasant Bay in Cape Breton. In Newfoundland, most of the commercial catch is made in the Conception Bay and Bonavista Bay areas.

Bad weather and ice-cover in the winter prevents fishing from November to April in the Gulf, so the fishing season generally lasts less than six months. In Cape Breton, it is restricted by regulation to about two months. In some areas off Newfoundland, where ice conditions are favorable, crab fishing may continue all year-round, except for a legal closure in January.

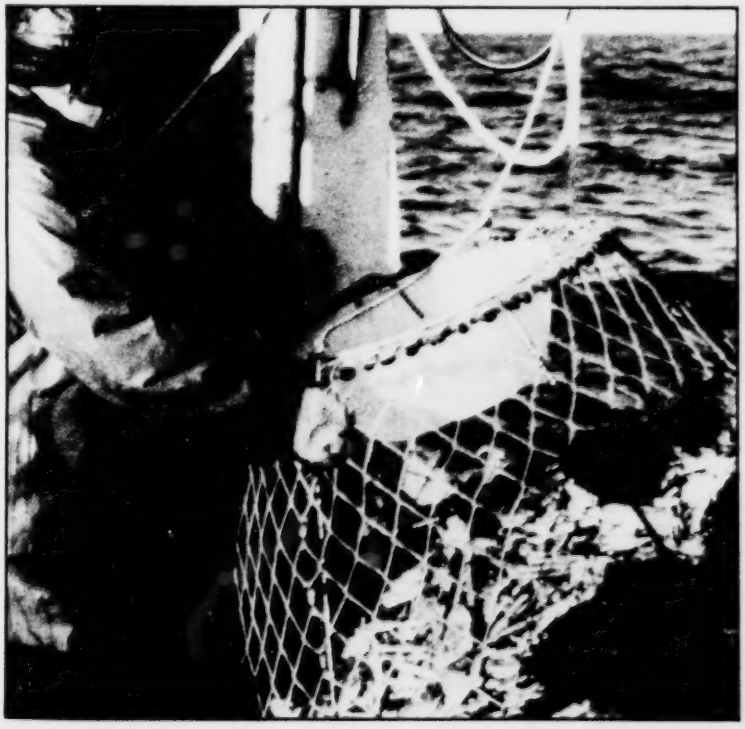
Resource Surveys

Resource surveys, it should be noted at the outset, include not only the preliminary effort to locate and quantify stocks of the various species. The term, as it is generally understood within the Atlantic Fisheries Development Program, also includes the development of harvesting and handling methods and technology; work with the processing sector to establish which species can be "pushed through" the system with sufficient value-added; and finally, marketing and/or feasibility studies (in cooperation with other Branches of the Department) to assess the biological and commercial viability of the stocks in question.*

*It should also be noted that projects described throughout this Report are intended as representative samples of the type of work being carried out and not as a definitive and all-inclusive listing of initiatives being conducted in each Region.



Queen (Snow) Crab in its natural habitat



Inshore Conical Crab Pot – Nfld.

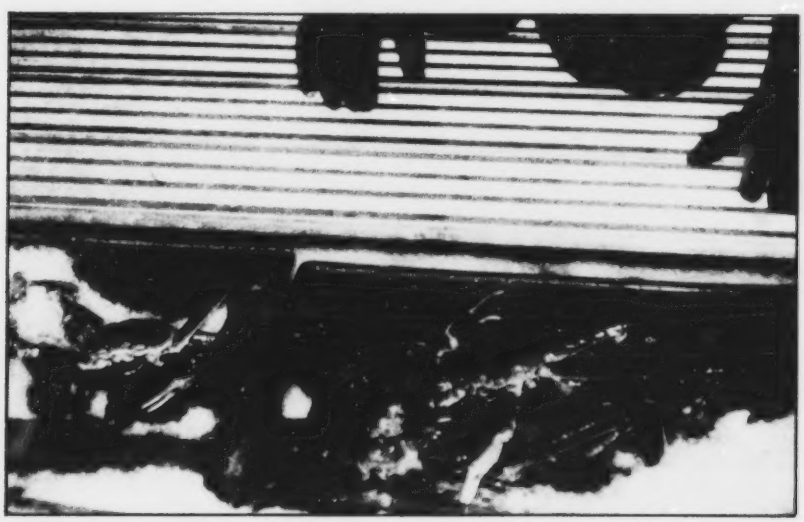
Inshore Exploratory Crab Surveys – Gulf Region

When market demand substantially increased for Queen (Snow) Crab in the early 1980's, industry interest in the resource flourished. Gulf Region, therefore, undertook a resource survey (1983) in Western Newfoundland to determine the extent of the resource in the area and its commercial potential.

Commercial catch rates in excess of 6.8 kg per pot were recorded in and around St. John Bay and these have resulted in three exploratory permits (200 pots/permit) during the 1985 fishing season. (At about the same time, a similar exploratory fishery was successfully undertaken involving 16 fishermen in the inshore zone north of P.E.I.)

Permanent commercial licenses, however, can only be issued upon confirmation of stock availability, subject to biological advice and senior management approval within DFO.

Typical Inshore Crab Vessel – Newfoundland

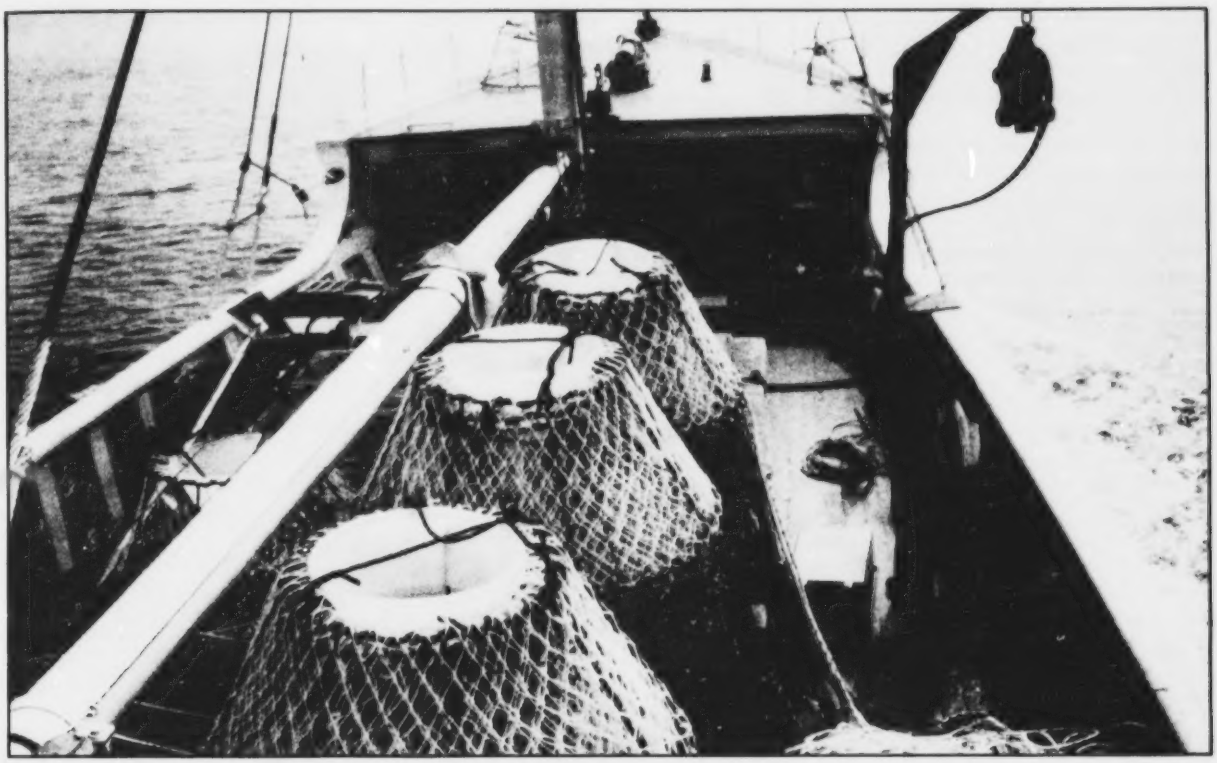


Containerized Snow Crab in the Hold – Inshore Vessel (Nfld.)

Offshore Crab Surveys – Newfoundland and Labrador

In recent years a number of crab surveys have been carried out in offshore areas off Eastern Newfoundland and Labrador.

Although the crab fishery is relatively new to the Region (late 1960's), inshore and nearshore stocks in many areas are already declining. With increasing demand for crab, supported by higher prices, it therefore becomes necessary to determine the potential of new fishing grounds. Only in this way can the crab fishery continue to remain viable.



Crab pots stacked on the deck of an exploratory vessel (offshore)—Newfoundland

Survey results off Eastern Newfoundland have varied with the areas covered, but, generally, information obtained helped fishermen increase their landings during the early 1980's by allowing them to range further offshore (up to 100 miles).

During the mid 1980's, landings declined off Eastern Newfoundland (Area 3L) with the result that many vessels were forced to abandon the crab fishery and turn to harvesting other species. Nevertheless, areas off Northwestern Newfoundland and Southern Labrador appear to hold considerable promise for a continuing crab fishery. Recent survey results indicate that the crab resource there is spread out over a large area and, while the catch per pot varies considerably, a fishery for most of the larger boats appears viable.

Of particular interest are the results of a survey off Southern Labrador which saw two vessels with experimental permits begin fishing during August 1985 and, over the next two months, land approximately 730,000 lbs. of good quality commercial crab. Plans are now underway for the orderly harvesting of this resource so that resident Labrador fishermen will receive the major benefit from it.

Because of limited processing capacity in Coastal Labrador, crab taken in 1985 were only partially processed there. They were cooked and iced and forwarded to plants in Newfoundland for final processing.

Development of the Shrimp Fishery – Scotia-Fundy

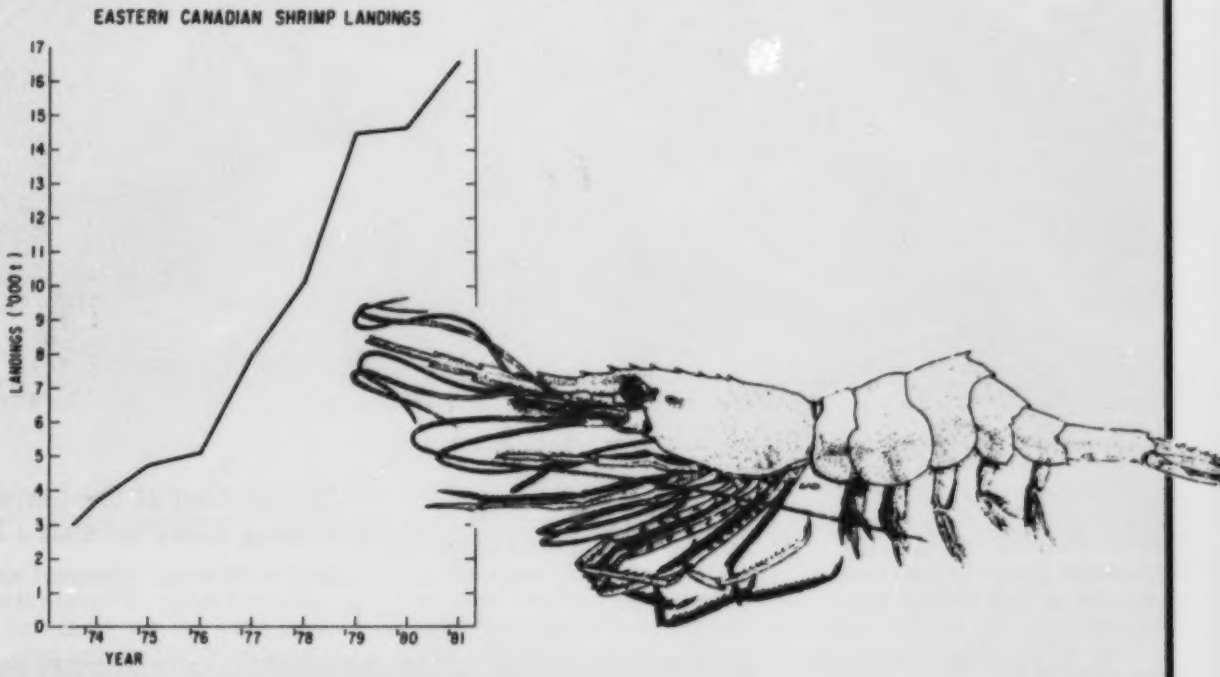
There are substantial reserves of shrimp off Eastern Nova Scotia which are only fished occasionally by shrimp trawlers from Northeastern New Brunswick. There are at present 16 shrimp licenses (40' to 64' vessels) in the area. These licenses are not now being fully utilized due, at least in part, to the absence of shrimp processing facilities in the Region. Processors have expressed interest, but are reluctant to acquire equipment due to a lack of assured supply of top quality shrimp and the uncertainty inherent in world shrimp markets.

In 1983, an AFDP project was undertaken to assist fishermen in Eastern Nova Scotia to land shrimp on a regular basis. The hope was to establish a shrimp industry based on Scotia-Fundy resources estimated at 5,600 metric tonnes.

In 1984, two 45 foot vessels were rigged for a pair trawl operation and began to fish in April, but fishing was terminated by the end of May due to declining shrimp catches and the lure of good groundfish landings. However, twenty-two fishing days produced a total catch of 44,300 lbs. in 58 tows. It is hoped that this degree of success will encourage other groundfish boats to rig for shrimp and thus broaden their commercial base of operations.

Another aspect of shrimping explored was the provision of containers to ensure that top quality product is landed and to facilitate unloading, interim storage and transportation.

The possibility of fairly large catches of shrimp combined with high-quality landings would appear to offer great potential benefit to Scotia Fundy fishermen. Progress in the fishery will be monitored closely during the coming year and, if there is sufficient interest on the part of fishermen, other new handling systems and procedures will be evaluated to complete the scenario.



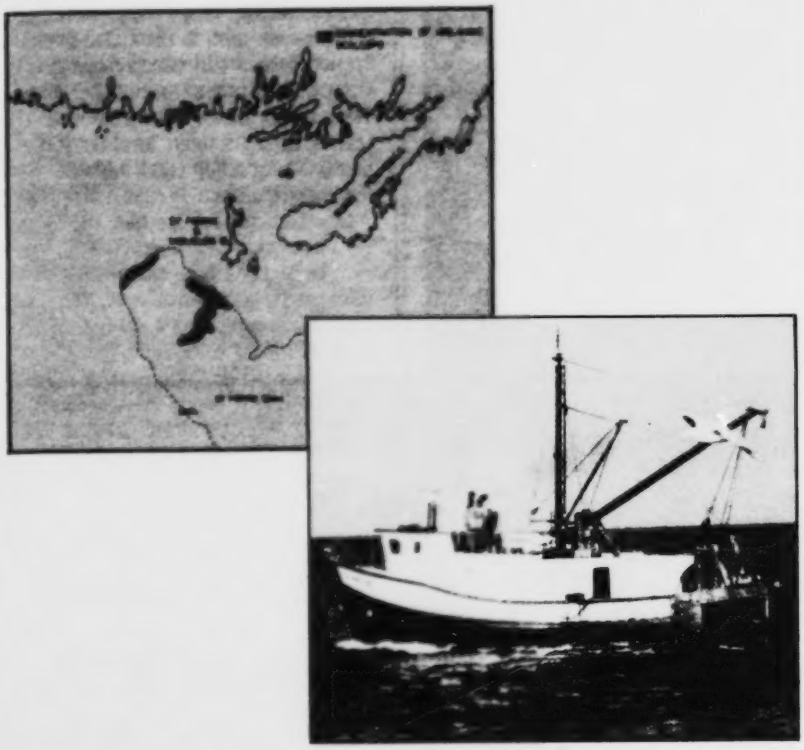
Pink shrimp

Shrimp fisheries in the Gulf of St. Lawrence began in the mid 1960s in the Sept-Îles, Quebec area. Fisheries have since developed on the west coast of Newfoundland in the late 1960s and early 1970s, and in an area north of Anticosti Island during the mid 1970s. In 1977, New Brunswick vessels participated in a relatively small fishery on the Scotian Shelf and large trawlers fished newly discovered shrimp concentrations in Hopedale and Cartwright Channels off the Labrador coast. The larger vessels extended their effort for shrimp into the Davis Strait area in 1978, and in 1980 a limited amount of fishing for the striped pink shrimp was conducted in the eastern Hudson Strait and Ungava Bay.

Vessels participating in these fisheries use small meshed otter trawls but both net and vessel size vary, depending on the fishery. Small stern trawlers (less than 20 m) are used on the west coast of Newfoundland for trips of one or two days' duration, while vessels from Quebec and New Brunswick generally are larger, capable of towing larger trawls and able to remain at sea for longer periods of time. The larger offshore stern trawlers in the Labrador Sea and Davis Strait use very large trawls and can remain at sea for a month or more.

The northern shrimp resources of Sept-Îles, Quebec and Port au Choix, on the west coast of Newfoundland are now being fully utilized. Shrimp stocks off Labrador and in the Davis Strait are fully exploited where catch rates have proven economical. Areas in the southern Gulf of St. Lawrence around Anticosti Island and on the Scotian Shelf, as this project illustrates, are becoming increasingly important as the industry expands.

Experimental Iceland Scallop Project – St. Pierre Bank – 1985 Newfoundland



The 60 footer used in the project on the St. Pierre Bank

Four bushels of Iceland Scallops per tow was the average harvest during the project

Experimental Iceland Scallop Project – St. Pierre Bank

The Iceland Scallop inhabits the Gulf of St. Lawrence, the Grand Banks and more northerly waters, and may be found in sub-arctic waters around the world. They usually prefer depths of 25 to 50 fathoms, but can be found in somewhat shallower waters off northern Labrador. They are also caught in the northeastern Gulf of St. Lawrence by multi-purpose longliners from Newfoundland's Great Northern Peninsula. The annual catch fluctuates widely because fishing effort varies from year to year. Sometimes other species are harvested instead due to higher prices or greater abundance.

During the fall of 1985, in an effort to discover new beds, a scallop fishing project was conducted on the northern edge of the St. Pierre Bank. Two 65' vessels were contracted and equipped by the Newfoundland Region. Work commenced September 9 and continued for 30 days.

The purpose of the project was to determine the viability of Iceland scallop fishing on the Bank using the larger inshore vessel. With their lower overhead than the offshore vessel, it was felt, they could economically fish the area and thus provide an alternative for fishermen experiencing difficulties fishing species other than scallops. It was also intended to decrease pressure on other stocks then being fished to the limit (eg. crab).

An overall average of more than 4 bushels of Iceland scallops per tow resulted. This translated into good commercial potential, however, the size of scallops on the Bank was smaller than expected (71 meats per lb.) which rendered manual shucking rather unproductive. Automatic shucking (aboard or on shore) must now be considered, and future plans call for the experimental application of this type of equipment. A scallop shucker being developed in the Scotia Fundy Region or an Icelandic system using hot water to open scallops may be suitable to the purpose.

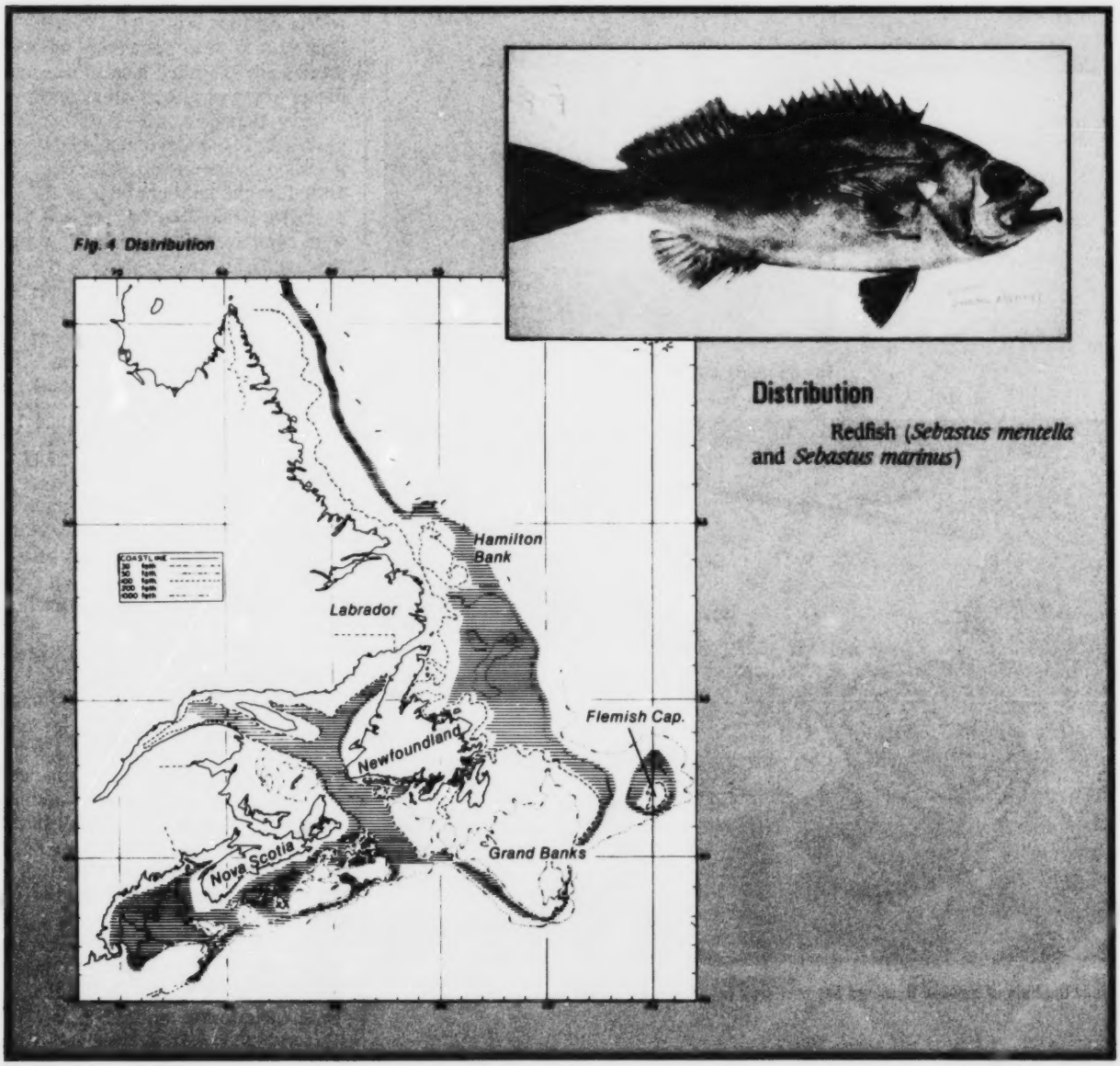
Redfish for the Japanese Market – Western Newfoundland (Gulf Region)

Commencing in late 1984, there has been considerable interest by processors in the Gulf Region in increasing the quantity of redfish landed by the inshore mobile dragger fleet. Interest has been primarily directed towards the strong Japanese market where quality is defined as a firmly textured fish that maintains its natural, bright-red coloration.

Considerable effort has been directed by the processing sector and both levels of government towards redfish as a means of alleviating fleet dependence on other groundfish stocks in the area.

During the third week of July, 1985, "The Ocean Way", a mobile dragger with 140,000 lb. capacity, set out in search of redfish. It covered an area about 40 miles off the Bay of Islands and in five trips brought in approximately 300,000 lb. of high quality redfish.

The project also involved the installation of an onboard diesel refrigeration unit, a Plate Coil Refrigeration System, in which freon gas is circulated in tubing around the hold. The system allowed the vessel to remain at sea longer, increasing the possibility of a full catch before returning to port.



An onboard system utilizing Petersen fish boxes (Yetterpak) and a marine crane to facilitate the handling and offloading of redfish was also installed to round out the package.

Since that time, prices area fishermen have received for quality redfish have been higher than those paid in the rest of the Gulf (on average). The fish are loaded on tractor trailers in Western Newfoundland, after processing, and shipped to St. John, New Brunswick where they are placed on a container vessel for the 43-day voyage to Japan. It is hoped that redfish will become an important contributor to both the primary and secondary sectors of the industry in the province and that long term sales to Japan will develop. The project has also demonstrated that co-operation between both levels of government and the industry can facilitate progress in the fishery.

Redfish Harvesting Projects — Newfoundland Region

Meanwhile, during July and August, 1985, a second Redfish Harvesting Project was conducted in the waters off the Northeast Coast and the Burin Peninsula of Newfoundland, respectively. The purpose was again, to determine the capability of inshore draggers to land redfish which would meet the specifications of the Japanese market and to determine whether catches would be large enough to support a viable fishery in the area.

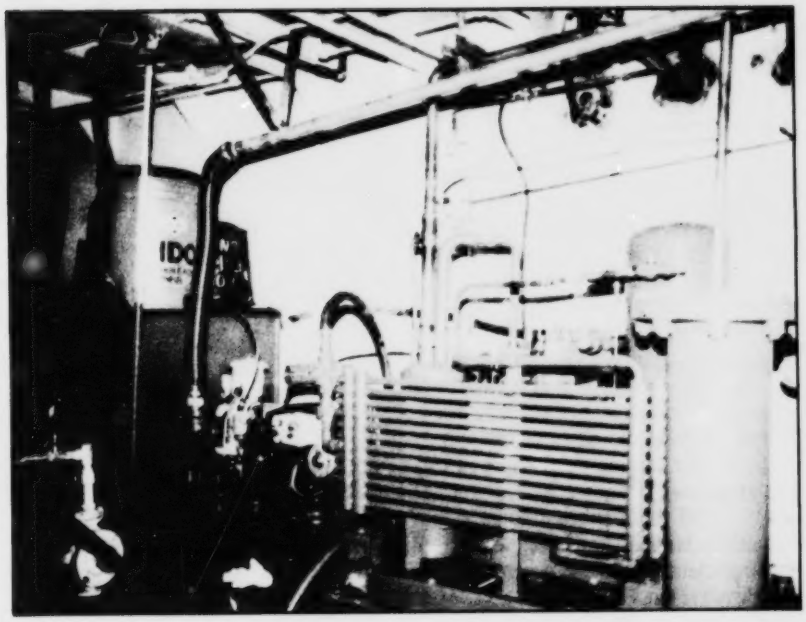


Plate Coil Refrigeration System

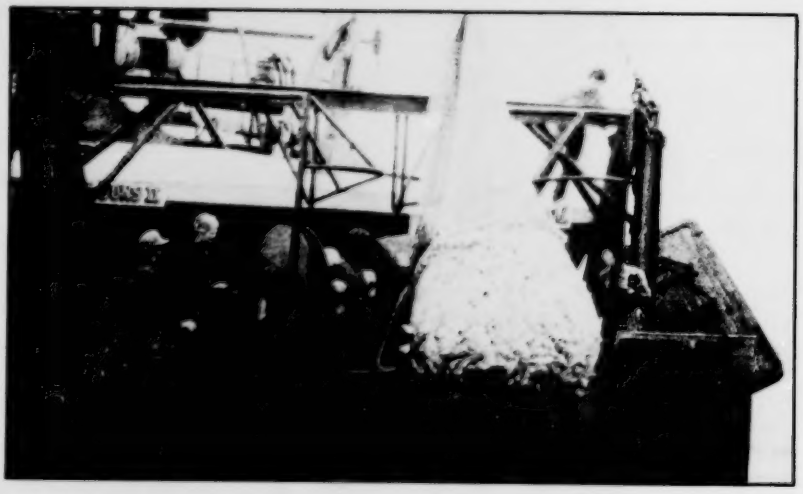
The project has created many new production jobs. Here we see part of a Redfish Processing Line — Western Newfoundland

The survey complemented an earlier experimental Redfish Project by the Newfoundland Region conducted during February and March, 1985. Although inconclusive, it had highlighted the potential for a commercial fishery – quality presented no problems, but quantity (catch rates) remained to be established after the first survey had been completed.

Two inshore otter trawlers were chartered to undertake the second project. Both vessels demonstrated the ability to catch and handle commercial quantities of redfish. The quality of fish landed, in boxes and in bulk, met the standard required by the Japanese.

Off the Northeast coast, quantities landed, however, were not sufficient to sustain a commercial fishery; on the South coast, the reverse was true. The commercial potential there proved to be excellent!

Catches were consistent from day to day; the fishing grounds lay within two hours steaming time; and the fish were large. Since completion of the project, one vessel has already fished the stock commercially. Good catches have been reported and the price per pound has increased quite substantially.



Redfish otter (bottom) trawl typically used by inshore draggers in the Newfoundland Region.

The ocean quahaug *Arctica islandica*.

The Stimpson's surf clam *Spisula polynyma*.

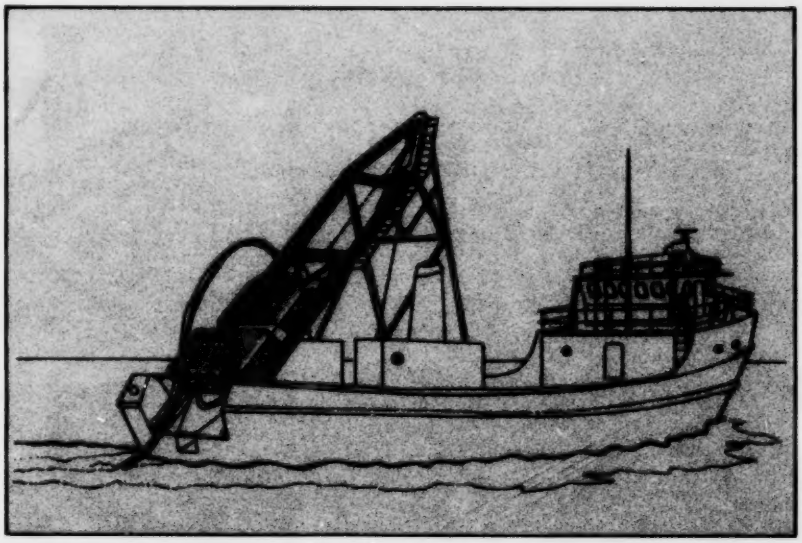
Northern propeller clam *Cyrtodaria siliqua*

Clam Surveys – Scotia Fundy/Quebec

In recent years, Scotia-Fundy Region has financed several surveys for surf clams and ocean quahaugs both offshore and in certain inshore areas off Nova Scotia.

An offshore survey was carried out on a chartered U.S. vessel using an electrohydraulic dredge. Areas surveyed included Banquereau Bank, Sable Island Bank and also Misaine, Artimon and Canso Banks.

Three major molluscan species were identified: Ocean quahaug (*Arctica islandica*), Stimpson's Surf Clam (*Spisula polynyma*) and Northern Propeller Clam (*Cyrtodaria siliqua*). Densities and biomass estimates have been determined for these species for each of the banks surveyed. As a result, several offshore areas have been identified for ocean quahog and surf clams as having commercial potential.



A modern commercial clam vessel of the type used in the U.S. fishery, rigged with a hydraulic dredge and stern ramp (Ropes 1980)

In the inshore surveys, ocean quahaug was the only species found in significant quantities. Densities varied widely throughout the survey area depending on bottom sediment type but, in general, were comparable to those found in the U.S., where an active fishery has developed over the last several years.

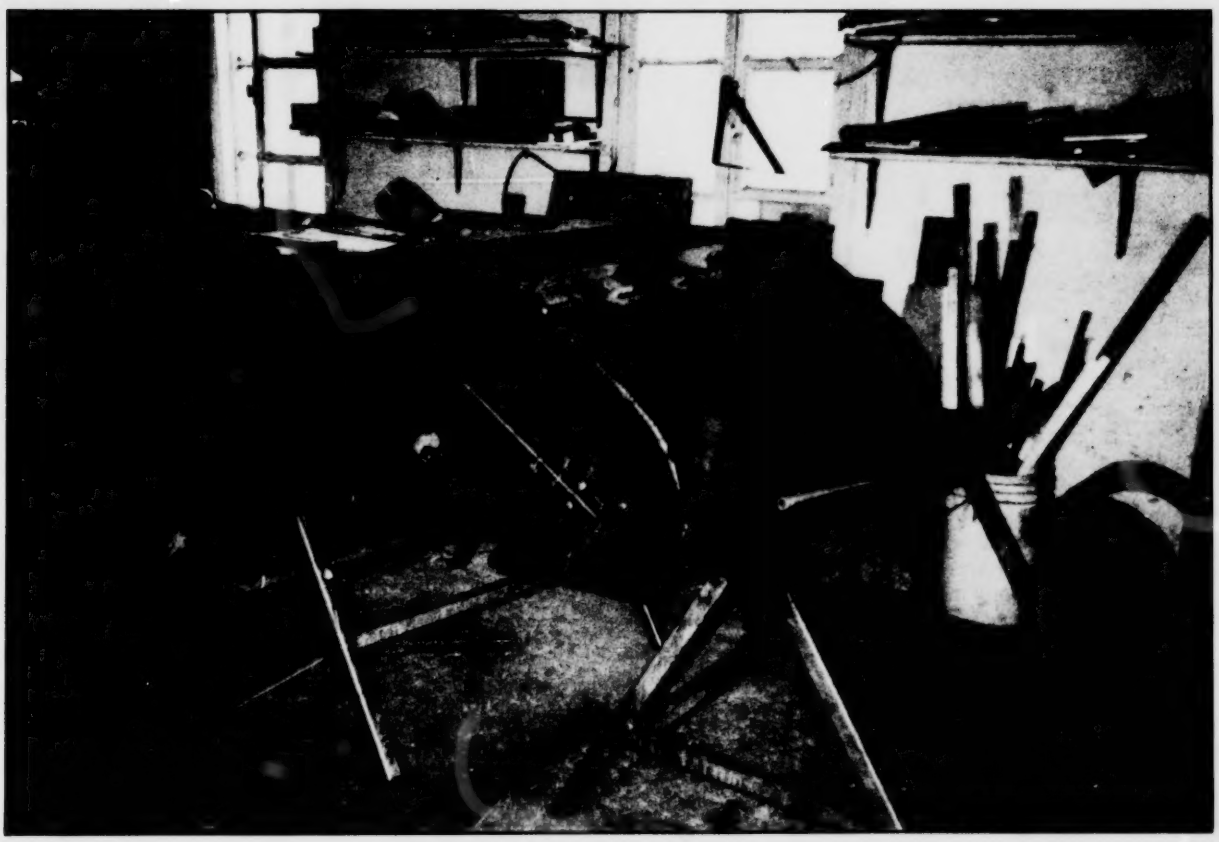
In addition to collecting information on distribution and abundance, biological specimens were taken and examined for growth, age, life cycle stage and meat yield in order to facilitate management of the stocks.

During the same period and for the same reasons, Quebec Region began to feel that there was potential for harvesting surf clams around the Magdalen Islands. After several requests from area fishermen, a crew was sent to Prince Edward Island to investigate harvesting methods in use there. A vessel was outfitted and exploratory fishing was initially undertaken in the southern sector of the Magdalens. Hydraulic dredging produced good catch volumes that first year (1984).

Additional work was, therefore, carried out during the 1985 season to establish whether the clam population could withstand the pressure of routine harvesting. In addition, a new dredge, one which is more selective than earlier models and more suited to local environmental conditions, was introduced to establish a controlled harvesting program.

It was established that the resource could support a modest fleet of 3 or 4 commercial vessels. Processing capability already exists to handle the additional volume. The DFO Research Branch would like to know, however, whether the stocks can sustain an annual harvest, before licences are issued to local fishermen. Some biological research is therefore necessary and, once this is complete, and provided the results are what the biologists would like, the Department can proceed with a management plan for the stock.

Not surprisingly, during the survey on surf clams, ocean quahog were also discovered in large numbers all around the Islands. These will require a similar evaluation regarding their commercial viability and it is hoped that this is an opportunity which can be pursued in the near future as well.

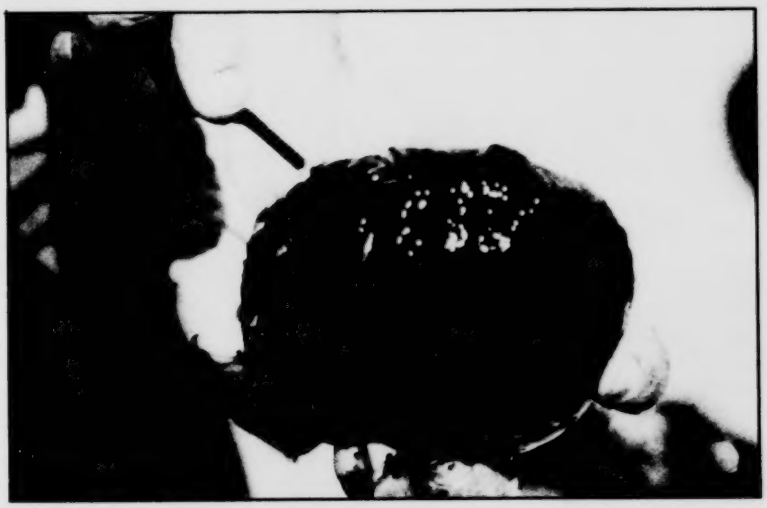


Sea Cucumbers

Sea cucumbers are not a commercial commodity in North America, but are considered a rare delicacy in the Orient. As luck should have it, sea cucumbers are plentiful in the waters off Scotia Fundy as a by-catch of several commercial fisheries, particularly scallops. In addition to being captured incidentally in most types of gear, they can also be harvested easily by hand as they are slow-moving and prefer shallow water. It is this fact which stimulated interest in the possibility of processing them for export to the Far East as a cottage industry.

Technical development of sea cucumber as food started six years ago. An investigation and evaluation of various techniques from catching and handling to processing has been completed since then. A company in Meteghan, Nova Scotia, began in 1984 to produce sample lots for export to Southeast Asia. Technical advice and some financial support have been provided to the company and to local fishermen.

Sea cucumbers are usually sold dried, but because they had never been commercially harvested, there existed no processing facilities to produce them. Seacrest Fisheries in Saulnierville, Nova Scotia, however, has responded to the challenge and work was begun to install the required equipment. At the moment, emphasis is being placed on developing markets for the species.



Sea "Cucs" being harvested using a rake; fresh; and drying.

Surimi Development

Surimi is a processed fish protein derived from mechanically deboned fish which has been washed with large quantities of fresh water, mixed with a small quantity of sugars, and frozen. The resulting substance is a stabilized, nutritious food base which is tasteless, odourless and retains its physical and chemical integrity in frozen form. Made from many different fish species, it is used as an intermediate material for a variety of processed foods. It represents the potential to convert low-value fish into high-value products and to move fish into non-seafood segments of the market.

The importance and potential impact of surimi is such that of five "Atlantic Working Groups" created under the AFDP during 1984-85, one has been asked to assess (through some preliminary R&D) how we might bring about its orderly development in Canada.* Attention has been devoted, primarily, to the issue of feasibility with an emphasis on problem/opportunity identification, investigation, definition, and quantification. But there can be no doubt that Canada has the potential to capitalize on the growing market for surimi-based products in the United States. We are geographically close to the American market and we possess large quantities of non-/under-utilized raw material which readily converts to surimi.

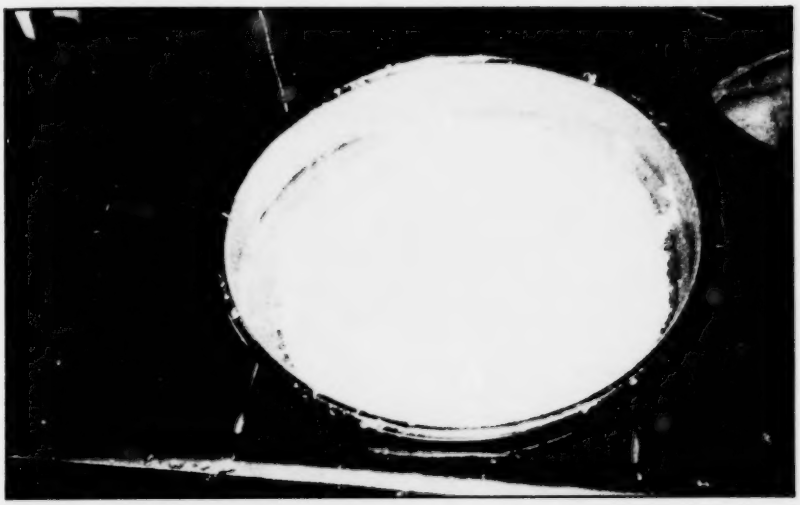
In 1984, a Newfoundland company, Terra Nova Fisheries, which had recently invested in this technology, produced some 400 tons of surimi from inshore cod purchased from local fishermen. This produced considerable interest in the fishing industry as to the potential for surimi production in Atlantic Canada, the technologies required, and the processes involved.

To help capitalize on this interest and to determine the proper extent of government participation in surimi development, a study was commissioned. It was conducted by Tavel, a Nova Scotia based consulting company, and investigated the potential for a surimi industry in Atlantic Canada. Recent developments in the United States, Europe and the Far East were examined. Since then, a D.S.S. (Supply & Services) contract has been put in place with the Newfoundland and Labrador Institute of Fisheries and Marine Technology. Work under this contract began in early September, 1985 to investigate the potential of different species to serve as raw material for surimi. Extensive laboratory support facilities have also been established.

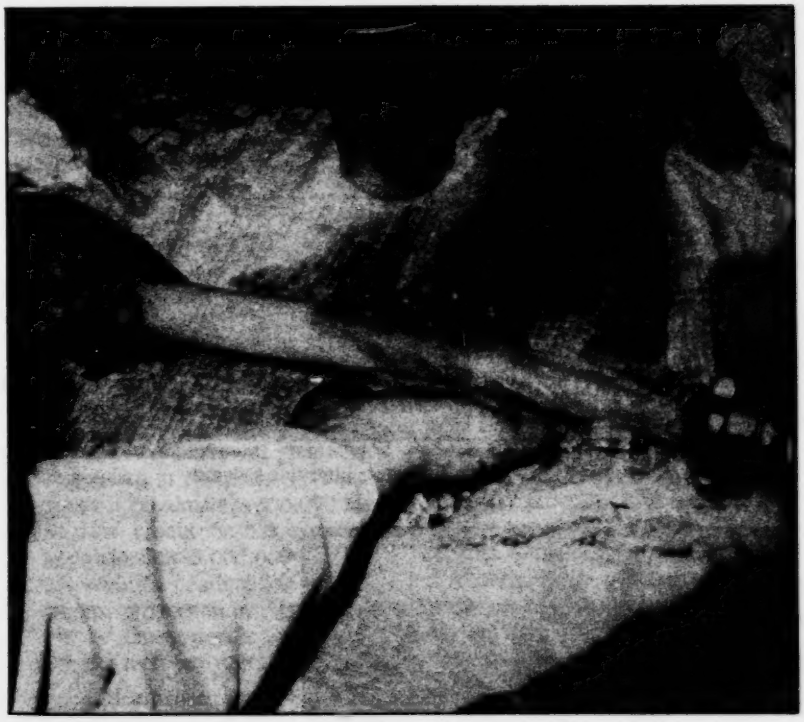
Surimi Product Display in a Japanese Supermarket

Scotia Fundy and Gulf Regions have contracted the Technical University of Nova Scotia to investigate the feasibility of producing surimi from under-utilized or problem species. To date, surimi has been produced from dogfish and herring carcasses – a by-product of the herring roe industry in Southwest Nova Scotia. (50,000 tonnes of herring are dumped annually, while the biomass of dogfish is estimated at 300,000 tonnes). Other lower priced groundfish species are also being used to some extent (eg. hake).

**See box – Atlantic Working Groups – at the end of this section.*



A Surimi Research and Development Program is ongoing at the Newfoundland and Labrador Institute of Fisheries and Marine Technology in St. John's. Above, surimi is processed from Atlantic cod. The fish is minced, washed, strained and de-watered to yield surimi. Below, surimi paste is extruded into casings and heated. It is then evaluated for gel strength, color, pH levels, moisture content and impurities.



Memorial University in St. John's has been sub-contracted by the Institute to investigate the use of by-products from crab processing as a source of flavoring and to assess the impact on surimi protein content of quality variation in the codfish.

Aquaculture

Traditional stocks of wild aquatic resources are not unlimited; some are being harvested at or near maximum levels or are actually declining because of over-fishing, pollution or habitat disturbance. Wild fisheries generally are facing difficult times, characterized by an over-capitalization and poor returns to fishermen. At the same time, world demand for quality fish and aquatic products is increasing and aquacultural activities are a means potentially available to increase the production of fishery products for which there is a demand.

Aquaculture has grown in recent years to the point where it now accounts for 12% of total world seafood production. On Canada's east coast, mussels are the fastest growing segment of the aquaculture industry, an industry that must, because of its increasing stature, learn to co-exist with the traditional fishery.

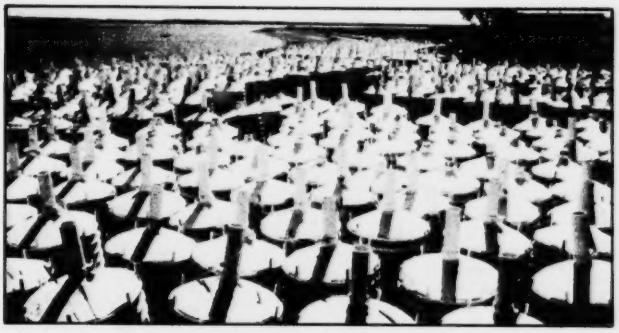
Aquaculturists in the Gulf Region essentially pioneered this challenging new industry in Atlantic Canada beginning about a decade ago with shellfish species. Oyster farming and, more recently, mussel farming in areas of Prince Edward Island and New Brunswick, have expanded quickly to other regions in Atlantic Canada.

By the year 2000, Maritime aquaculture could be a $50 million/year industry and could have created thousands of jobs (it is not only labor intensive, but generates spinoffs in related areas). Salmon, mussels and oysters will continue to be the most important and most viable species.

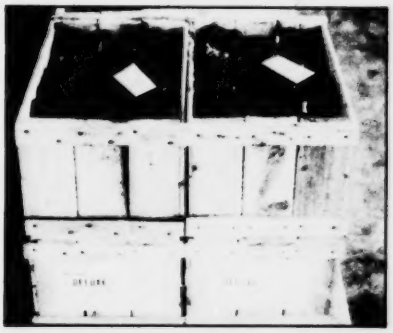
Of all the aquaculture industries, however, salmon farming has the glamor and gets the headlines. Overall, the Maritimes produced cultured salmon worth about $1.4 million in 1984. These figures doubled in 1985.

Those facts notwithstanding, other species also represent significant opportunity.

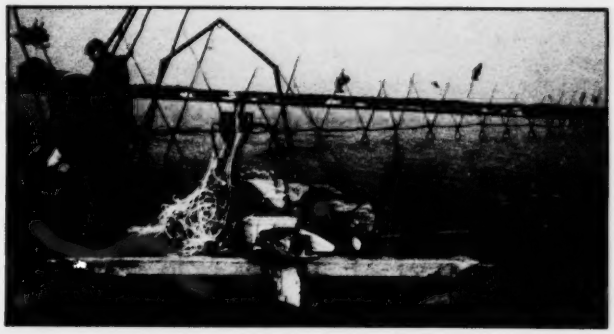
Oyster Growing



1. Preparation of Collectors ↓



6. Final Product – graded oysters (deluxe) ↑



2. Installation of Collectors ↓

5. Growth period using Japanese Lanterns (Japanese baskets and vexar bags are also used) ↑

3. Collectors after two seasons ↓

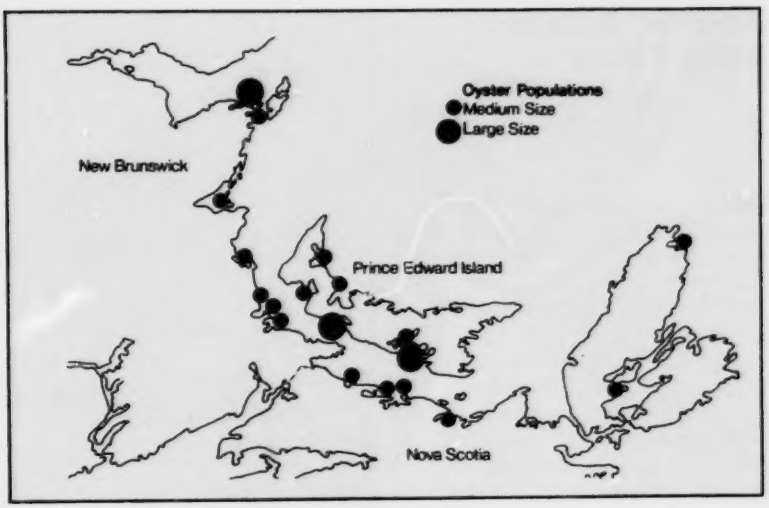
4. The spreading of Oyster seeds

DFO has typically provided technical assistance and demonstrations and, over the years, has served as a catalyst for technological advancement in the industry. In New Brunswick over the last decade, the oyster industry was first centred on public bed enhancement by desilting, dragging shell bottom, cutting eel grass, etc. in an effort to increase spat collection. Also, private bed lessees have been picking wild seed oysters to stock their beds and have increased the incidence of spat collection by setting their own collectors. In recent years, based on culturists advice, the province has redirected its efforts by endorsing private bed enhancement. In an agreement with the private sector in 1985, 12 million seeds (oysters about 2.5 cm in length) were produced and will be sold to 20 aquaculturists during 1986. It is anticipated that, within 6 years, this will increase annual oyster production by 50%.

In Prince Edward Island, the overall oyster production strategy also centres on enhancement of public beds. Oyster relocation has been carried out at a number of specifically identified locations recognized as good growing areas, and with the added advantage of minimizing winter losses due to heavy ice conditions.

Other recent oyster enhancement activity on the Island includes: the spreading of oyster shell as a cultch for spatfall collection, desilting oyster and shell beds to increase spat fall, natural spat collection and starfish control. For example, in Bedeque Bay, P.E.I., enhancement programs were initiated in 1972 when production was approximately 500,000 lbs. Since then, production has increased to approximately 3,000,000 lbs. for 1985. With the continuation of these programs, production in this area should be almost double the '85 total within the next ten years.

Meanwhile, Scotia Fundy Region has been at work on the European Oyster as well.



Principal oyster producing areas of the Maritime Provinces

European Oysters

The objective of this project was to develop and evaluate hatchery procedures for commercial production of the European Oyster, ***Ostrea edulis***. This type of oyster has been shown to have a tremendous market potential in North America; it grows well in Canadian waters; and it has a consistently better shape than the native oyster for the half shell trade. But it needs warmer temperatures to reproduce, so farms must be supplied with seed oysters from a hatchery.

Experiments were carried out at Dalhousie University where a pilot hatchery operation has been established. Several million oyster seeds have been produced annually. A commercial hatchery will now be established to supply an increasing number of growers in Nova Scotia.

And, while, to quote one industry observer, "the jury's still out on how commercially viable the technology is", a small number of growers produced 50,000 oysters, worth about $20,000 in 1984.

The hope, of course, is that another commercially viable "fishery" will be the result of all this activity.

Submersible Raft/s for Shellfish Culture

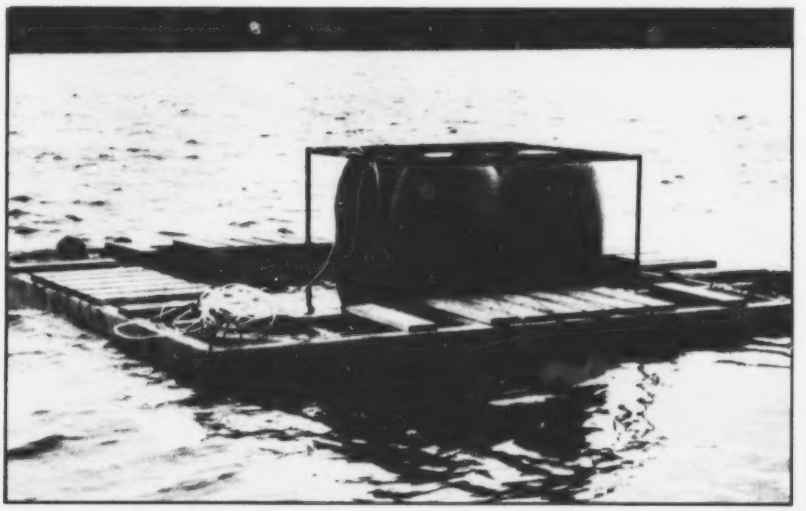
In 1982, Scotia Fundy Region funded a project to design, fabricate and field test a submersible raft suitable for culturing mussels, oysters and other shellfish. The structure could be submerged in order to reduce or eliminate the risk of damage due to predation, ice, vandals, boats and heavy seas. The project was jointly funded between the Department of Supply and Services and DFO, Scotia-Fundy Region.

Initially, three prototype rafts were designed and constructed by the contractor, the Technical University of Nova Scotia, and were subsequently tested and evaluated at the Nova Scotia Department of Fisheries aquaculture facilities at Ostrea Lake. One of the three, an underwater raft, floats about 2 metres beneath the surface. The added protection that this affords leads growers to believe more mussels will survive to make it to market. The major cost in off-bottom culture is floatation. This raft is efficient and inexpensive. Its size can be varied depending on the buoyancy provided, with the basic unit carrying one 189-litre plastic barrel. It is anchored by half-barrels of concrete.

While it may take a while for growers to change over, it is a good start and the price is right. At least the new design promises to be less costly than the present longline system using lobster buoys. One unit, with capacity for 22 mussel-laden lines, produces 2,200 pounds a year, costs about $60 and should last longer than the 5-10 year lifespan of most surface rafts.

The submerged rafts should be a boon to more heavily populated coves in the region. Homeowners and cottagers will appreciate that floating structures no longer interfere with their visual enjoyment of the shoreline.

Prototype Rafts designed, constructed and evaluated for AFDP, Scotia Fundy Region by the Technical University of Nova Scotia.



Mussel Farming

During the 1970's, Nova Scotia and P.E.I. developed the technology for culturing mussels, and started promoting the tasty shellfish just as demand was developing. Production has increased drastically since 1982, going from 170 tons that year to 876 tons in 1984. In 1985, close to 100 growers produced more than 1,500 tons of mussels, worth more than $1.5 million (U.S.). New Brunswick is also active in mussel farming technology. 100 tonnes of wild mussels were harvested there and sold locally in 1985.

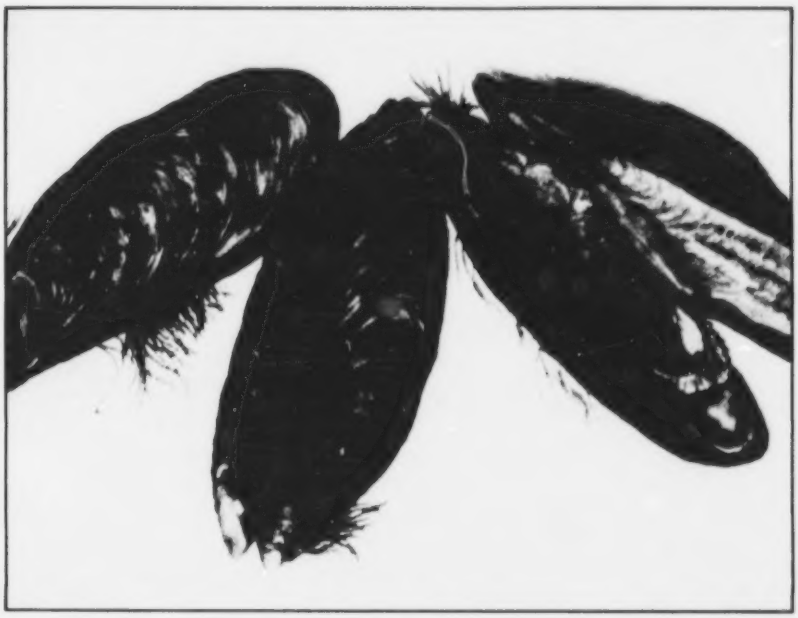
Thinner and darker shelled than wild mussels, the cultured mussel is grown suspended from ropes hanging from buoys five to ten feet apart. This results in a mussel free of sand and mussel pearls, both very unpleasant if bitten into by an unsuspecting diner.

While the mussels grow to market size, taking from one-and-a-half to two-and-a- half years, growers must protect their crop from predation and bad weather. But the potential for market expansion appears almost unlimited and, therefore, well worth the effort.

Gulf Region hopes to increase the annual production of cultured mussels tenfold by 1990 for a market value estimated at $8 million/year.

Assistance to the cultured mussel industry has taken the form of technical transfers and joint projects designed to reduce labour costs and to improve culturing, harvesting and processing technology.

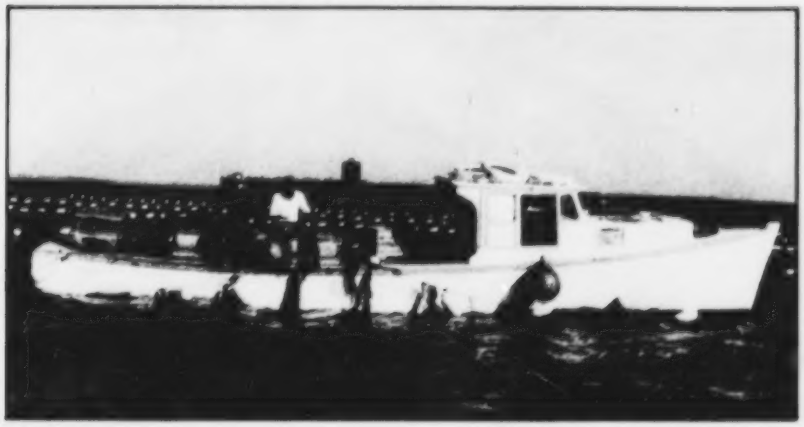
Over the last three years, production has doubled annually. During this period, D.F.O. has assisted the industry through a variety of projects relating to summer and winter harvesting, stocking-filling equipment, de-clumpers and graders, methods of increasing yields for stocking, improved floatation and anchoring systems, and to various aspects of processing.



Wild Blue Mussels

Cultured Mussels

Mussel Culture Activity in P.E.I. – Summer and Winter



Summer Harvesting

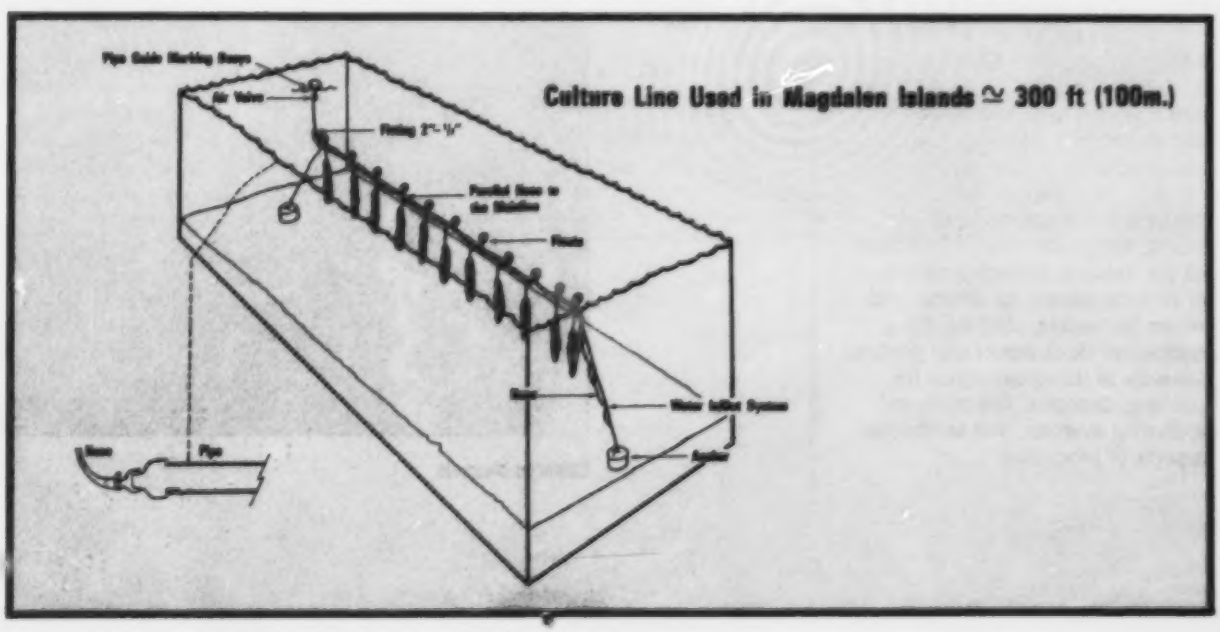
Winter Harvesting

Winter Mussel Farming in Quebec

Mussel farming is never easy; this is especially true during winter. Quebec Region was very much aware of this when it decided to help develop mussel farming on a commercial basis in that province.

Ice can cover a mussel suspension system for months at a time during the winter and this makes it difficult to sustain volume output (the farmer cannot easily harvest his market-sized mussel stocks when they are covered by ice). The concept tested in Quebec (a longline system attached to pipes) is designed to be submerged to a point where it does not freeze into the ice cover. When mussels must be harvested, the pipes can be pumped full of air and raised (floated) to holes cut in the ice for that purpose.

Unfortunately, unfavorable weather conditions during the summer of '85 destroyed most of young mussels being bred for the experiment, as well as almost 70% of the equipment required. This dictated that the project be scaled down to the point at which it was really not possible to prove the viability of such a system. For now, it's back to the drawing board.



Typical Fish Rearing Cage (trout) – P.E.I.

Salmonid Enhancement

While most salmonid aquaculture on the East Coast until now has been carried out for public stocking purposes within government hatcheries, considerable interest has also been demonstrated by independent aquaculturists, and a number of projects have been undertaken. Several commercial operations are now in place and are expanding to produce rainbow trout, brook trout and salmon.

Projects undertaken under the AFDP have been directed toward design and construction of seaworthy fish rearing cages to be used in rivers and estuaries.

Sea cage technology has moved ahead in leaps and bounds in the past 2-3 years throughout the region. This has been aided by the development of vaccines, improvements in fish food quality and the health of the rearing stocks themselves. The fish culture industry on P.E.I., for example, is now at a very delicate stage in its development. The infrastructure is in place to service a large expansion in the industry. All that is required is ready access to the necessary venture capital.

Meanwhile, one serious problem facing salmon farmers in Southwestern New Brunswick is seals. Salmon have traditionally been grown in cages constructed of twine which offer little protection against marine mammals. A seal attack can and has resulted in the loss of an entire year's production.

Scotia-Fundy Region has supported a local salmon farmer, working with staff from the St. Andrews Biological Station, in designing and building a new "seal-proof" cage constructed of coated wire mesh. The new design has undergone testing over the past year and it has proven effective. In addition, storms which can adversely affect fish held in traditional cages do not affect those held in the new cage. It is expected that other farmers in the industry will switch to this new cage design in the near future; some European aquaculturists have already expressed an interest.

Lobster Farming in Pounds – Quebec Region

Earlier semi-intensive lobster farming experiments carried out in the Magdalen Islands concentrated on improving yields in order to deliver a quality product for market testing. The purpose of the experiment was to test the practicality of bringing canner-sized lobster to market size in captivity.

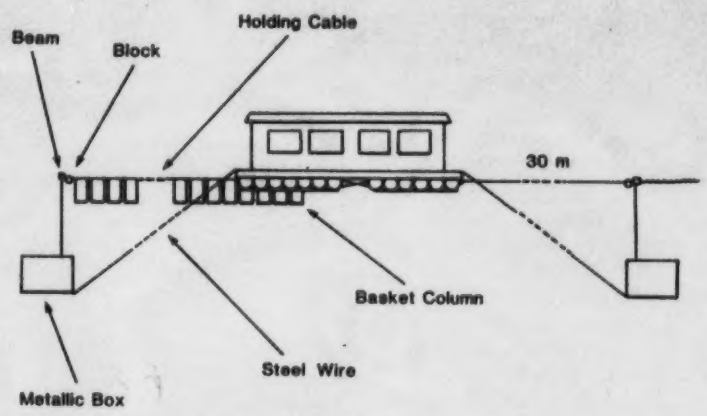
The introduction of canner-sized lobsters to the system was scheduled for only one month – July, 1984. But feeding, maintenance and market operations continued until the end of December, with the growing period spanning several months. Lobsters grow well in the relatively warm weather that prevails at that time of year.

Small wild lobsters bought from area fishermen were kept in salt water lagoons on the Magdalen Islands where water is almost the same as in the nearby ocean. Of the 6,749 lobsters in the culture experiment, 2.64 percent died during the growth period. Initially, the average lobster weighed 426 g. The average weight when they were removed from the holding tanks was 580 g (a 35.8 percent increase). During the feeding process, the lobster diet consisted mainly of common crab (5,477 kg). But by mid-September, when crab supplies were depleted, they were fed "extruded" pellets and young mussels.

The study showed that, to achieve an acceptable level of return, further research and development work must be done on various automated systems needed to support lobster farming. This work is being supported by other government programs.

Automating the support structure and the feeding operations can yield a production volume of approximately 115,000 lobsters

Lobster Suspended Culture System



|50 m.t. at purchase will represent nearly 68 metric tons at the end of the growing period when lobsters are market size (usually in November/ December when prices are highest)|.

Commercial viability of lobster farming in Quebec has now been established. At this point, it simply remains for the industry to take up the DFO lead and pursue the opportunity on a commercial basis.

Aquaculture in Newfoundland

At the present time there are four aquaculture operations in Newfoundland. They are in the very early stages of development and involve private individuals investigating the potential for the commercial cultured production of mussels, scallops, salmon and trout. Commercial operators in some areas have indicated that potential does exist for profitable production. An aquaculture advisory board (DFO, Province of Newfoundland, Memorial University and others) is now being established to evaluate proposals, co-ordinate aquaculture efforts and develop an aquaculture strategy for the region.

Development objectives for aquaculture in Newfoundland, at the moment, are limited in scope. They are:

- to assist private industry (aquaculturists) to acquire the necessary growing and harvesting technology and techniques to commercially produce cultured mussels; and
- to provide mussel growers with an awareness of developments elsewhere in Atlantic Canada and on the international scene.

Atlantic Working Groups

In 1985, five Atlantic Working Groups were established: 1) Surimi, 2) Energy Conservation (excluding gear); 3) Parasite Detection and Removal; 4) Onboard Handling, Holding and Offloading; and 5) Technology Transfer.

1) With Surimi, there is still considerable potential for traditional and currently non-/under-utilized species (e.g. male capelin, dogfish, and herring carcasses). The first priority of this Working Group, therefore, will be to develop uses for traditional species currently being discarded; the second will be to encourage broader development of a surimi industry based on non-/under-utilized species. This strategy would expand the commercially harvestable resource base and offer fishermen an alternate source of revenue. It would also relieve pressure on overfished stocks.

2) The most obvious legacy of the recent energy crisis has been an inexorable escalation in the cost of fuel. Nowhere has its impact been felt more directly than in the fishing industry. Atlantic Canada has been particularly affected: the total fuel bill in the Region (1984) was more than $160 million. As a result, a Working Group on Energy was formed and charged with preparing a comprehensive program for reducing energy usage in the harvesting sector. Originally, it was to concentrate on hulls and propulsion systems. Recently, however it was decided to expand the mandate of the Group to include fishing gear and equipment, and thereby to complete the energy equation.

3) The problem of parasite detection and removal is costing the fishing industry tens of millions of dollars a year. The AFDP, through the efforts of the Working Group on Parasite Detection & Removal, includes a 3-year program to improve traditional candling techniques, to develop a means for automatically separating parasitized fish and to develop technology for the automatic detection and removal of parasites. There is new willingness on the part of the industry to commit both people and financing to a joint government/industry program. This could necessitate a modified group-structure involving a government/industry steering committee and the appointment of a full time project manager.

4) It was also decided this year (1985) to address in a positive way the issue of inconsistent quality in Canadian fish products. An Atlantic Working Group on Handling, Holding and Offloading was established to co-ordinate a program which has the potential, within 5-7 years, to generate an estimated $80 million/year in additional revenue. Improved quality of raw material will increase yields and produce a finished product which will command a better price.

A second concern is the obsolescence factor affecting the existing fleets in Atlantic Canada – both inshore and offshore. Over the next five years, approximately 70% of the offshore fleet and 85% of the inshore fleet are due for replacement. With vessels and propulsion systems being looked after by the Energy Working Group, that leaves systems and equipment for the handling, holding and offloading of fish to be developed so that modernization is complete with the next generation of fishing vessels. This means containers and the systems to render them viable, hence the need for this fourth Working Group.

5) Finally, in Technology Transfer, significant progress has been made to standardize project documentation, to coordinate publications and workshops, to ensure that material is properly catalogued and available to libraries, etc. An important consideration here is recognition of the fact that the AFDP has three client groups: the first is the fishing industry, which requires practical, comprehensible data to make day-to-day decisions; the second is the technical/research/teaching community, which requires precise, detailed technical data; and the third is the public who seek fairly general information on the fishing sector – past, present and future. Working Group 5 is in the process of developing specific strategies to meet the needs of each of these client groups.

COST REDUCTION

Objective: To reduce the Cost of Harvesting, Processing, Handling and Storage of Fish and Fish Products—

to minimize costs in order to increase incomes to those who derive their livelihood or who benefit in other ways from the fisheries.

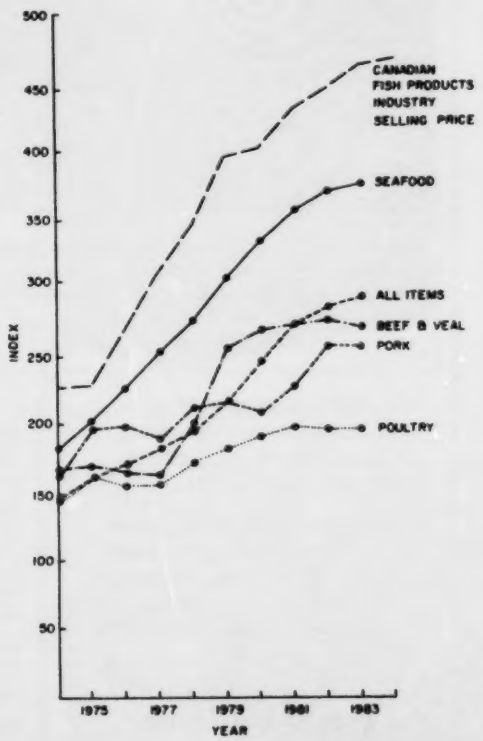
In at least one sense, not much has changed since the Task Force on Atlantic Fisheries, in December, 1982, identified cost reduction and productivity improvements as priority areas on which to focus development activity. Both primary industry (fishermen) and secondary industry (processors) have for several years now complained that operating costs are too high.

The effect of high fuel prices on fishing and processing costs, for example, has been well documented and might represent as much as one quarter of the landed value for some species. This component of the Atlantic Fisheries Development Program has primarily been aimed at reducing fishing costs through vessel and gear improvements, but some work on plant productivity has also been carried out. There have been extensive investigations into energy use by fishing vessels to develop methods, techniques and guidelines for adoption by owner/operators to achieve improved energy efficiency and reduced costs. Though results vary from vessel to vessel, ways and means to achieve significant savings have been identified.

Processing costs can be lowered and waste reduced if the quality of raw material entering the plants is improved. But sub-optimal product mixes also contribute to lower prices and reduced profit margins. The challenge, then, is to maintain consistent quality and to develop a much stronger market orientation.

Of ever increasing importance in the coming months, however, will be efforts to bring technology to bear on the problem of parasite infestation of groundfish on the east coast. A problem of great sensitivity, stemming as it does from the growing seal and whale populations, it will require joint industry-government action. Parasite infestation translates into increased labor costs, reduced yield, lower quality product, reduced efficiency and potential negative impact in the marketplace. And with technological solutions estimated to be several years away, we do not have a minute to lose!

Canadian fish products price index and U.S. consumer price indexes. (R. Verge, AFTC, April 1985).



From 1970 to 1983, U.S. per capita consumption of poultry products increased from approximately 48 pounds to over 65 pounds per year, while red meat products experienced a drop in consumption.

Why didn't some of the demand shift toward seafood? The answer lies in consumers' perceptions of the value they receive when they purchase different products.

From 1967 to 1983, the consumer price index for seafood products in the United States grew at a much faster rate than the corresponding index for many of the nearest substitute foods. The index for poultry increased least.

Prices Canadian fish processors received for their products increased even more rapidly from 1967 to 1983 than the U.S. consumer price index for seafood. We cannot reasonably expect, therefore, to be able to continue to increase prices indefinitely. Future success will be a function of our ability to control costs.

Energy Consumption (Vessels)

The most obvious legacy of the recent energy crisis has been an inexorable escalation in the cost of fuel. Nowhere has its impact been felt more directly than in the fishing industry.

Atlantic Canada has been particularly affected.

The total fuel bill in the Region (1984) was more than $160 million. As a result, a Working Group on Energy was formed in January, 1985 and charged with preparing a comprehensive program for reducing energy usage in the harvesting sector. It would concentrate on hulls and propulsion systems (excluding gear). Vessels under 65' LOA (over 30,000 of them in Atlantic Canada) consume 43% of the fuel and most do not operate at present at optimum fuel efficiency. Those over 65' (middle distance and offshore vessels) consume 45%, but have been professionally designed and engineered and, although aging, are relatively efficient. There is still scope for government involvement at this level, but it has been estimated that targetting the 35 to 65' vessel, the most likely candidate for wholesale improvement, and achieving a mere 10% reduction in fuel consumption, would put over $7 million a year onto the income side of the ledger for fishermen (and this does not include what could be saved by their simply trottling back). The strategy adopted by the Energy Working Group to achieve this level of performance is straightforward:

- to provide individual vessel owners with an energy analysis to identify ways and means to reduce existing levels of consumption and, therefore, operating costs, i.e., the development and refining of a computerized vessel energy analysis system, and to
- continue to collect data on the 35-65' vessel and, to a limited extent, on other classes through both model testing and sea trials, and to gather and communicate this information to the industry.

The Ener Sea Van – this "vessel energy analysis system" consists of a computer hardware/software unit housed in a van for easy access by most Newfoundland fishermen. It has also been taken "on location" to various Special Events in the other Atlantic provinces.

The Ener Sea Program

The first component of this strategy is the Ener Sea Program being carried out by the Newfoundland Region. A computer program was developed to analyse Newfoundland vessels in the 45-65' range for engine and propeller match; the effect on fuel consumption of a reduction in speed/RPM; and the cost benefit of suggested propeller changes.

The number of vessel operators who have been in contact with Ener Sea staff to take advantage of the program is encouraging, but perhaps the most important development is the growing interest in the service industry, particularly among propeller manufacturers/distributors, naval architects, and marine engineers. It is hoped that this will result in new vessel design which incorporates energy efficiency as an important parameter.

The direct impact on the fuel expenses of fishermen who have used Ener Sea is difficult to establish. But those attending DFO seminars indicated they would reduce their operating RPM by an average of 188. When applied to base data, this represents an average saving of 18.5% on the total cost of fuel.

The system continues to be developed with the intent of expanding the program to encompass vessels in all Regions in the 35-65' class.

Vessels and Propulsion Systems

The second component of this strategy is multi-faceted. It includes:

Coatings for Wooden Vessels

A study completed in March, 1985 by Scotia Fundy Region has thoroughly documented existing practices for coating wooden hulls, identified problem areas and made recommendations on how wooden boat owners should treat the underwater portions of their hulls.

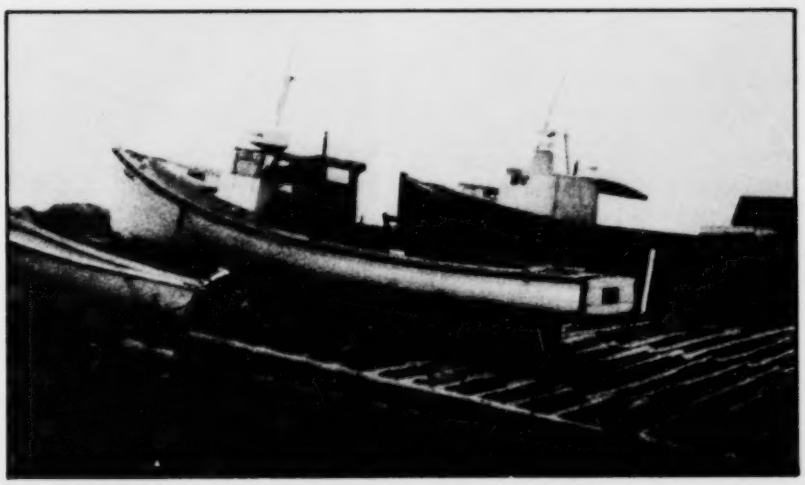
The study showed that inexpensive coatings used by most boat owners are probably cost-effective in view of the roughness of most wooden boats before coating and the frequency with which most small boats are dry-docked or beached for cleaning and painting.

An untreated GRP (fibreglass) hull

But the study uncovered a number of related facts which should be brought to the attention of the industry.

(a) Fiberglass boats generally are in worse underwater condition than wooden boats because owners tend not to paint them. And there are paints available for GRP boats – vinyl anti-fouling coatings.

(b) There is confusion in the industry regarding shipworm and gribble. The former will bore into wood weakening the structure and require replacement of planking. Gribble only attacks the surface and, while it may look bad, usually is not serious. However, some owners are needlessly replacing planking damaged in this way.



One type of ramp used to "dry dock" small vessels (up to 44ft.) in the Maritimes.

(c) Anodes are being improperly used to protect metal underwater structure. In many cases the anode strips are being directly attached to underwater metal parts providing a short circuit and virtually no protection. In other cases, small anodes are attached to protect large unpainted metal surfaces but, again, are totally inadequate.

Cathodine protection (c.p.) is installed on most vessels as a supplement to protective hull coatings. However, many configurations offer little or no protection to metal fittings.

An ongoing communications effort has been mounted to make vessel owners aware of the problems which exist and the relatively simple solutions which lie very close at hand. The positive effect of this work on fuel consumption in the Region should prove almost automatic.

Bulbous Bows on Trawlers

Anyone who has spent time around a shipping port has seen protruding bulbous bows on ships and tankers. They are most noticeable when the ship is unladen or trimmed by the stern with the bulb only partly submerged. The design of these bulbs has developed to the point where few ships of any size (except icebreakers) are now built without them.

A sample of gribble infestation in a wooden hull – at the waterline

Oak rubbing strake infested with teredo (shipworm)

Cathodine protection (c.p.) is installed on most vessels as a suplement to protective hull coatings. However, many configurations offer little or no protection to metal fittings.

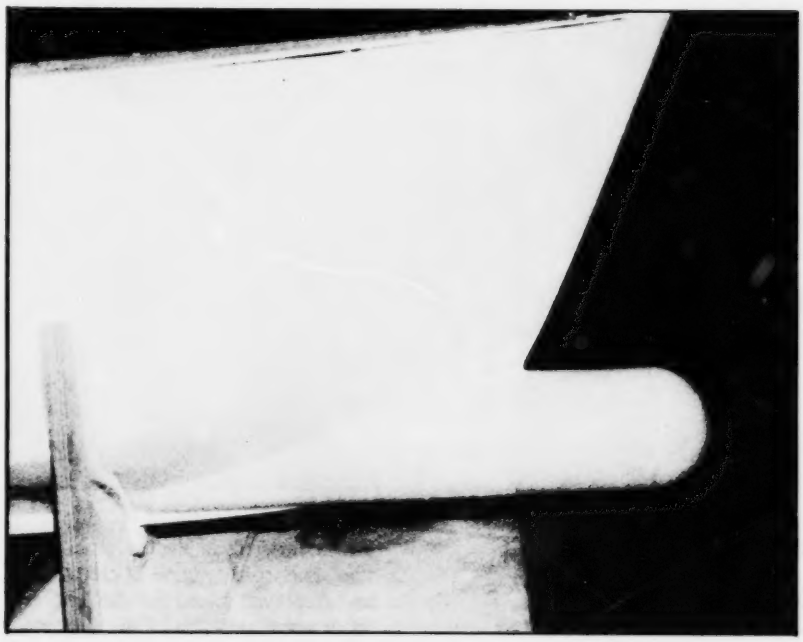
Their primary purpose is to reduce the power needed to drive the hull through the water. This may surprise those who might associate a knife-sharp bow with speed and efficiency. But the beneficial effect of bulbous bows was noticed over a century ago on men-of-war hulls with ram bows.

The most important effect is the reduction of wave-making resistance at cruising speeds. For vessels such as fishing boats, which are driven at high ratios of speed to length, wave-making resistance is the most important part of total drag.

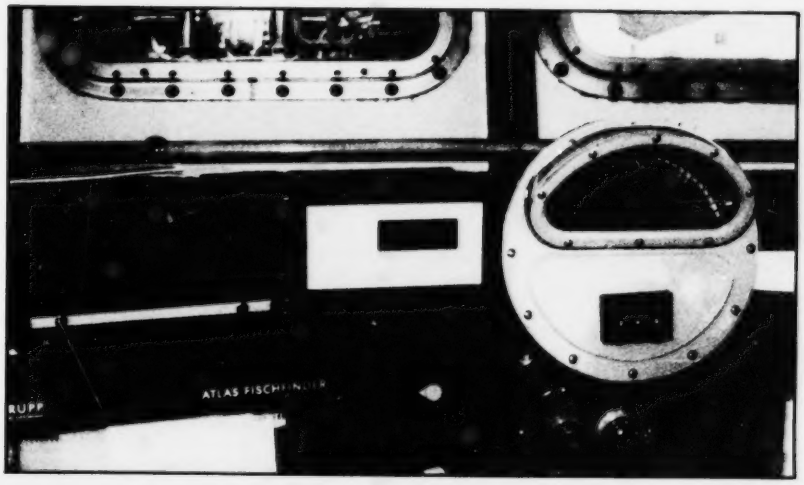
The objective of this Scotia Fundy project, then, was to study the effect of bulbous bow retrofits on the resistance and seakeeping capability of offshore trawlers.

Calm water and seakeeping model resistance tests were performed in a test tank on the bare hull of a 50-metre trawler model of the Canadian offshore fleet. Models were fitted with varying sizes of bulbous bows. The results showed that large diameter bulbs are more effective at high speeds, whereas small diameter bulbs are most effective at low speed. The length of the bulb also affects resistance, with the shortest bulbs being most effective. All bulbs resulted in a decrease in vessel pitching motion in head seas. Data from this project will permit a more judicious choice of optimum bulbs for existing or new trawlers; this, in turn, will facilitate effective future management of the fleet.

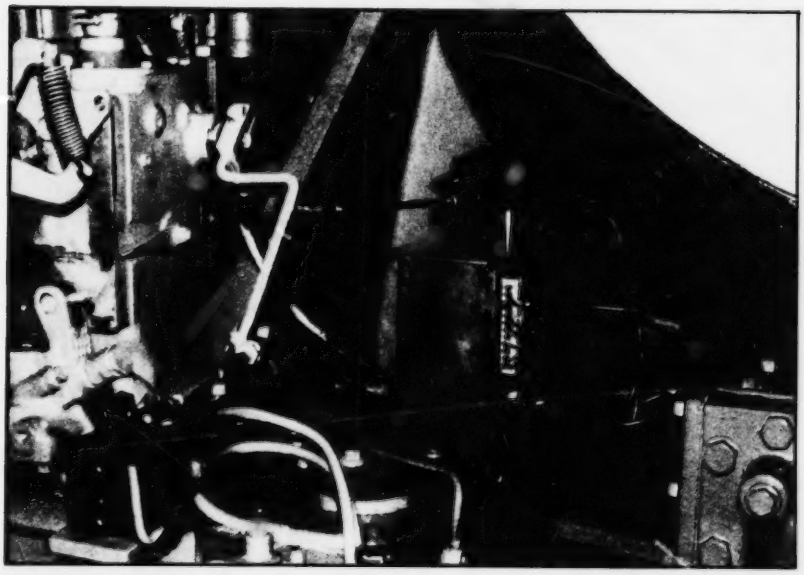
Other Problems — Algae, Polyzoa, Mussels and Hydroids



Bulbous Bow – Trawler Model



Fuel rack sensor – bridge control panel (above); engine room component (below)



Fuel Sensor for Diesel Engines

Because of difficulties experienced in measuring fuel flow onboard fishing vessels using fuel meters, an alternative system utilizing the fuel rack position has been proposed and tested by Scotia Fundy Region. The system consists of a fuel rack position measurement system and a signal display unit in the wheelhouse. The rate of flow is based on a measurement of the governor position. Fuel consumption is calculated and displayed based on that and in a linear approximation of the fuel consumption curve supplied by the engine manufacturer.

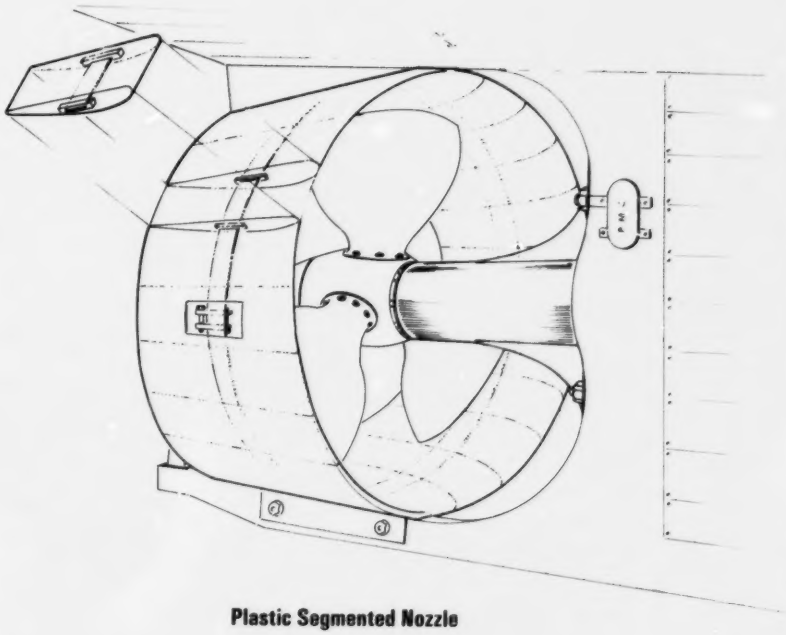
The system was installed onboard National Sea Products' *Cape Brier* and, after several test runs, it was concluded that measurement of fuel rack position provides a simple, reliable system for measuring fuel flow onboard. The system appears sufficiently inexpensive for widespread application in engines having an accessible fuel rack control mechanism. As a result, DFO has recommended that the system be installed on all offshore trawlers in Atlantic Canada.

Plastic Nozzles

The installation of an aerofoil cross section nozzle around a propeller will provide more thrust at towing speed in comparison to an open propeller. This additional thrust can be used to either tow a larger net for a specific power setting and rate of fuel consumption or to tow the same net at a lower power setting and rate of fuel consumption. Either way, the harvesting operation becomes more efficient. It remains for the operator to decide whether the increased net size or the reduction in fuel consumption is more advantageous.

To avoid custom designing a nozzle for every small fishing vessel, Scotia Fundy Region has developed the concept of the Plastic Segmented Nozzle (P.S.N.). This design involves the assembly of a series of standard-shaped segments together in some appropriate diameter. The segments are post-tensioned together by an internal steel band to create a solid unit.

Full-scale sea trials of the (new) plastic nozzle were carried out in 1985. Plastic represents an alternative to the traditional steel nozzle and has been estimated to cost about one third as much to purchase (if produced commercially on a large scale). Thus, there is a double benefit here – reduced fuel consumption and reduced cost for the nozzle itself.



Plastic Segmented Nozzle

National Sea Products Trawler "Cape Verde" (St. John's) in ice off Newfoundland

A System to Measure Ice Loads on Fishing Vessels

Each year, millions of dollars are spent repairing damage to offshore fishing vessels damaged in ice-infested waters. Most of these vessels have been ice strengthened on the basis of past experience, rather than from established knowledge of probable ice loads.

The objective of this project was to provide information on ice loads experienced during typical fishing operations so that design information would be available for future vessels.

Scotia Fundy Region contributed funds toward this work, as did DSS (Supply and Services) and DOT (Transport). A National Sea Products trawler was instrumented at the bow and ice loads were measured during a trip off Newfoundland. The system successfully monitored the loads, and data are now being collected on an ongoing basis.

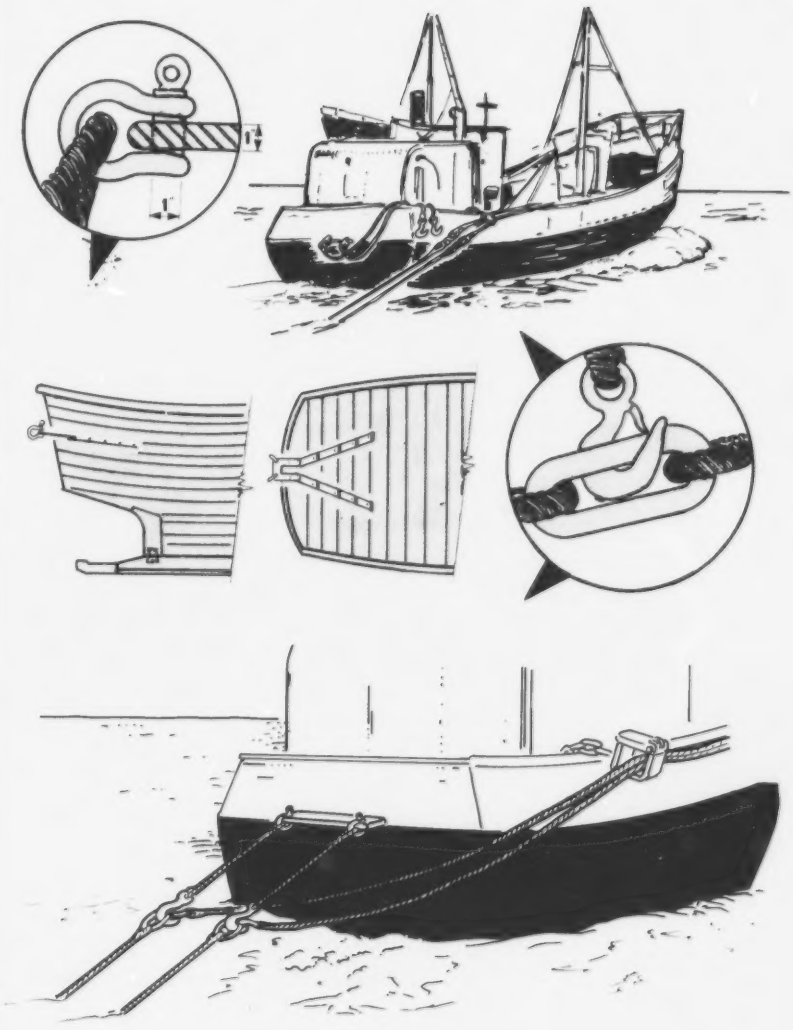
Wire Guide System for Side Trawlers

Side trawlers are less manoeuverable and less fuel-efficient than stern trawlers. A high proportion of the fishing vessels in the Gulf Region, especially in the shrimp fishery, are side trawlers.

The main characteristic of these vessels is that the entire force needed to tow the trawl is concentrated on one side, usually the starboard side.

In an effort to improve manoeuverability and fuel consumption on side trawlers, a wire guide system was installed as a pilot project on an 87' shrimper (1985). This system is a simple concept developed to redistribute the forces of the pull when trawling. It allows a side trawler to function as a stern trawler i.e. to tow its trawl from the stern of the vessel. Improved manoeuverability and increased fuel efficiency was the result.

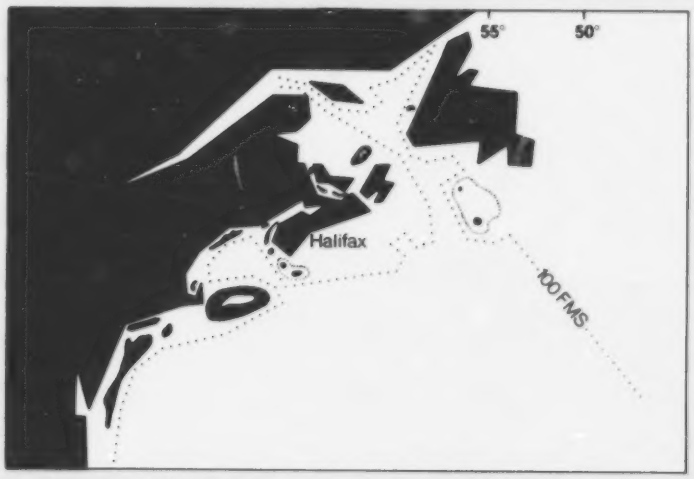
Savings of up to $500 per trip are possible using this system and it is also possible to fish more hazardous grounds. As a result of this project, the system has already been adopted by other vessel owners and many expressions of interest have been received from fishermen in both New Brunswick and Quebec. At last report, monitoring equipment to measure fuel consumption is in place and fine tuning of the system is being carried out.



The Wire Guide System permits side trawlers to fish from the stern.

Gear

The other aspect of the energy equation as far as fishing vessels are concerned is gear. In fact, 75-80% of the fuel consumed by the mobile-gear fleet is directly related to the towing of gear. Work being done as part of the AFDP is meant to improve the energy efficiency of both harvesting equipment and methods. To date, this has involved new approaches to the design of scallop rakes, the modification of seine/trawl gear, paired operations and the application of "high-tech" equipment to the fishery.



Locations of important sea scallop fisheries on the Atlantic coast.

Sea Scallops

Sea scallops are found in the northwest Atlantic, from the Gulf of St. Lawrence to Cape Hatteras, North Carolina. In the northern part of their range, they occur in water shallower than 18 m. (10 fathoms), while in the southern portion they are confined to waters deeper than 54 m. (30 fathoms). Where conditions are favourable, scallops occur in dense populations, called beds, which may be extensive enough to support commercial fisheries. Important Canadian fisheries have occurred off Georges Bank, in the Bay of Fundy, on the southwestern Scotian Shelf, and in the Gulf of St. Lawrence.

About 75 per cent of Canadian scallop landings come from Georges Bank, a large Bank extending eastward from Cape Cod and site of the largest single scallop resource in the world. The northwest peak of the Bank is about 90 nautical miles SSW of Nova Scotia.

Faced with declining catches on Georges Bank, the offshore fleet is expending considerable effort on scallop beds of the eastern Scotian Shelf and on St. Pierre Bank, south of Newfoundland.

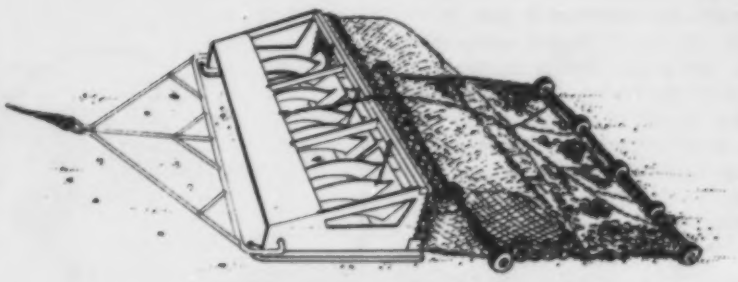
Offshore scallop vessels sail out of several Nova Scotian ports. The fleet began with one small dragger in 1945, and since 1973 has been restricted to 77 licences.

In recent years, both the Bay of Fundy inshore vessels and the offshore fleet have exploited scallops extensively on the southwestern Scotian Shelf.

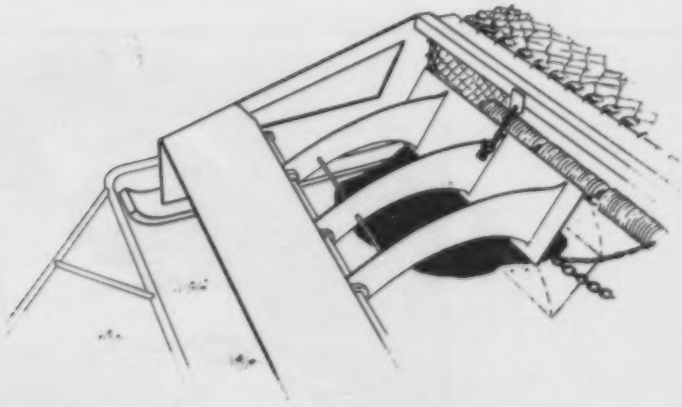
Scallop Rake Improvement

Scallop landings were up in Nova Scotia in 1985. The value of the scallop fishery – the Cadillac of the Nova Scotia fishing industry – has climbed to $51.5 million from $46.3 million. That is still down from a 1981 boom, which generated landings worth $88.3 million – one-third of the total value of a $263.7 million fishery, but is still considerable. However, the problem of fuel consumption in the scallop fishery is critically important. Ongoing design work (prototype construction and sea trials) on new rakes is aimed at reducing initial drag due to bottom friction and accumulated drag from the collection of rocks in the rake, and at reducing the mortality rate of scallops left on the bottom.

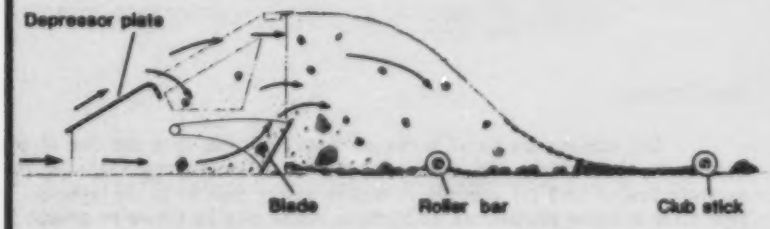
DFO researchers estimate that traditional rakes have efficiency levels as low as 8% and only as high as 15%. And, the mortality rate of scallops over which the rake passes is said to reach 25%. The objectives of current development work are to reduce fuel consumption by a conservative 2% (an offshore scallop vessel expends about $1,000 per day for fuel) and to harvest an average of 10% more scallops. This result will come about because of the extra efficiency of the new rakes, rakes which also ensure a significant reduction in the mortality rates of uncaught scallops.



Scallop Rake Prototypes – the object of ongoing experimentation in the Scotia Fundy Region, DFO.



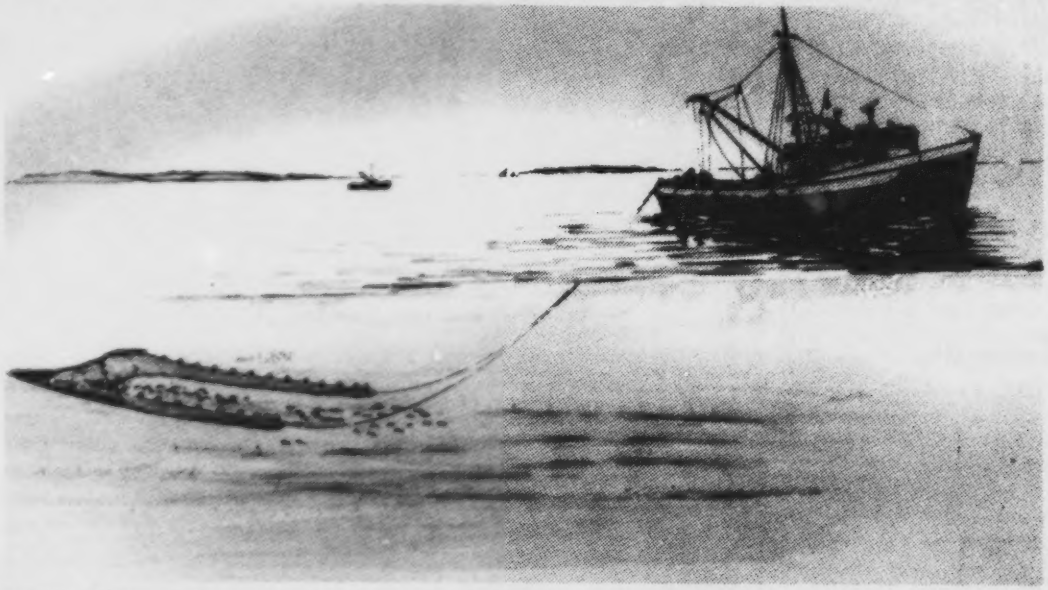
Prototype scallop rake showing hinged blade (one of three) in raised position encountering large anchored rock



Prototype scallop rake (side view) arrows indicate water flow direction

NOTE: Rocks fall over the blade, through the chains, under the rollers and, therefore, are not caught in the bag. Scallops are forced up by the water flow and into the bag.

Scottish Seining

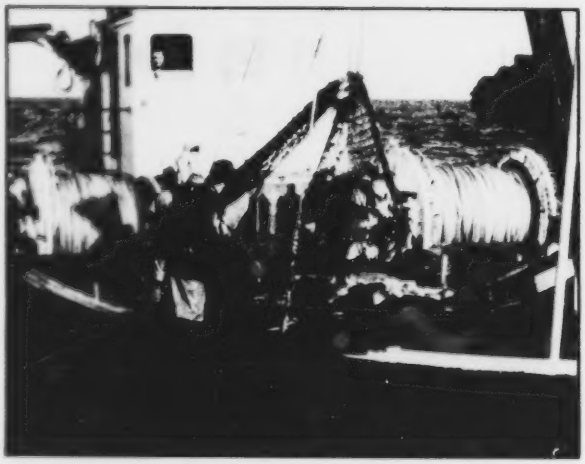


Scottish Seining methods are used to catch groundfish species over smooth bottom. A seine net and a series of ropes are spread out pear shaped along the ocean floor. The action of the ropes during the hauling process stirs up a mud cloud that herds fish into the path of the net.

In the early days, the rope was coiled on deck as it was hauled in; later it was coiled in bins in the hold; still later, after winching, it was wound on two large reels. These were introduced to Canada in the early 1970's by DFO, an example of technology absorption. A Canadian invention (by Fisheries Development technologists), the self-hauling rope reel, was introduced early in the decade. A variation on the theme is the dual purpose rope reel introduced in 1983-84.

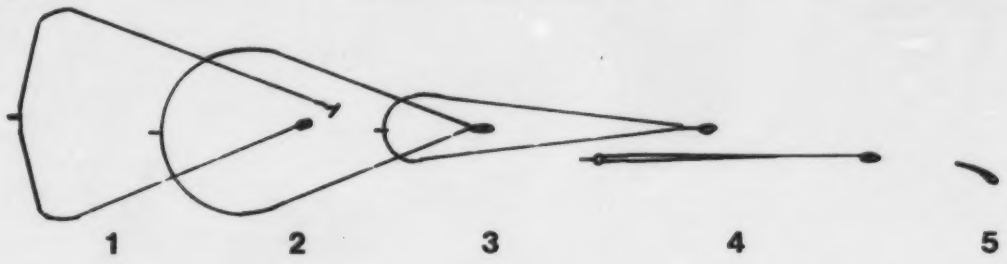
Dual Purpose Rope Reels (for Scottish Seining and Trawling) – Scotia Fundy Region

An extension of the basic rope reel principle, dual purpose reels cut by two-thirds the cost of replacing ropes and by 20% the cost of rigging a vessel. At present, fishermen



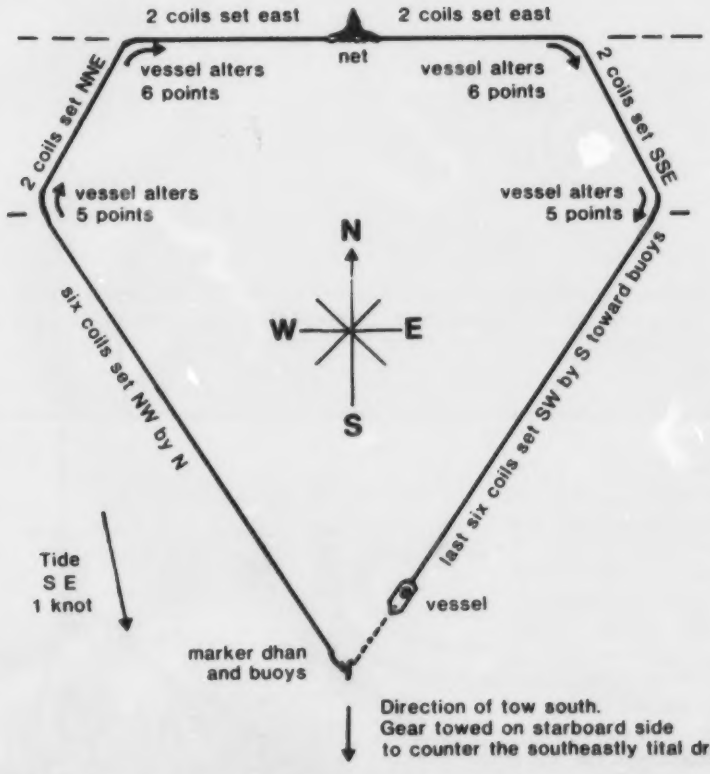
Self-hauling rope reels aboard "The Monique H" off New Brunswick

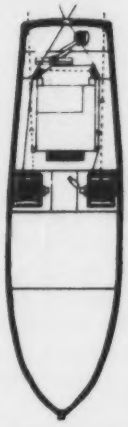
Scottish Seining **Movement of the gear during a tow**



1-Gear set out; 2-Towing commences; 3-Gear closing; 4-Gear closed; 5-Net up.

Setting the gear.

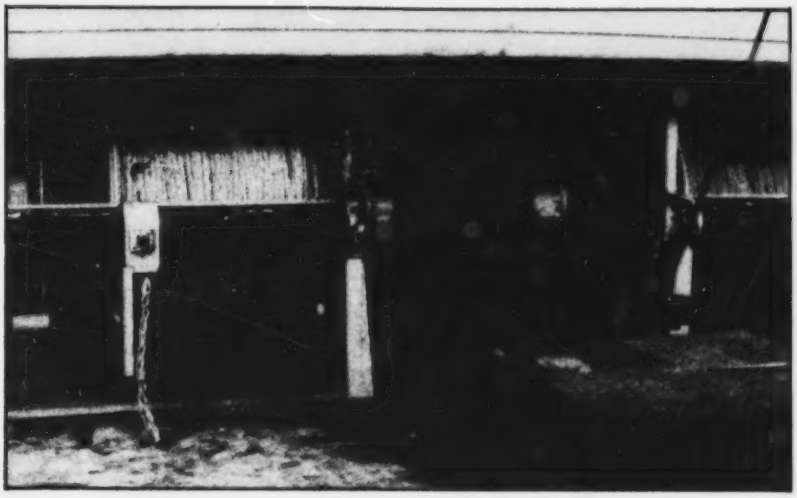




Vessels tows and hauls slowly at same time.

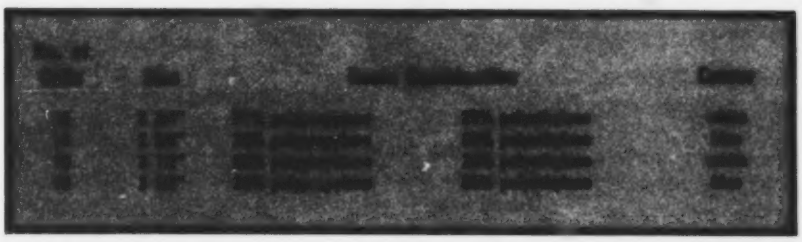
Scottish Seining. Bottom fishing with ropes. Ten to 14 coils of rope warps 2 3/8" to 3 1/2" circumference. Each coil measures 120 fathoms. (1800 fathoms or more in total).

in the trawl/seine fleets pay about $1.2 million a year for ropes and about $185,000 to rig each vessel. The most exciting element here, however, is that when rough bottom is encountered, fishermen will now be able to change from Scottish seining to trawling in less than 20 minutes and without leaving the fishing grounds. In the past, they had to return to port to switch gear.



Combination fully-powered reels for Trawling and Scottish Seining. The capacity of each reel is 9,000 feet of rope plus 4,200 feet of trawl wire; there is a dividing flange on each reel. Change-over time from trawling to Scottish seining or vice versa is approximately 20 minutes. The reels shown above are located under the bow of "The Jessie and Shelly" out of Sambro, N.S.

At the stern, the drum (above) is used to haul and store the seine/trawl after all the wire has been hauled and wound onto the reels at the bow. In the foreground is the crane and power block used to haul the Scottish Seine and the bag of the net.



Prototype Scottish Seine Ropes

The rope used in seining must be of negative buoyancy to lay on the bottom, must be resistant to wear and tear from the sand, rocks and gravel encountered and must be of tight, hard lay to reduce the absorption of fibre-cutting sand. Negative buoyancy is achieved by including a lead core in each of three strands.

A previous attempt to manufacture :hese highly specialized ropes in Canada had been made and had failed. However, Scotia Fundy gear specialists felt that this could be attributed to a lack of knowledge of the fishery and inadequate testing and modification procedures.

A decision was made to produce ropes from combinations of 80% polypropylene, 20% polyethylene and from 80% polyethylene, 20% polypropylene. Construction would be entirely of flat filament tape to inhibit the entry of sand into the strands. Nova Stran Ltd. of Saint John, N.B. was commissioned to do the work. Both combinations produced good results in lab testing, but the final decision on their suitability was made by fishermen under commercial conditions.

Accordingly, 40 coils were produced for testing.

The ropes were extensively tested in Nova Scotia and New Brunswick with three different types of hauling machinery. The overall consensus was very positive for the white rope (80% polypropylene, 20% polyethylene), however, the composition of the blue ropes (80% polyethylene, 20% polypropylene) was not considered suitable for Canadian vessels.

Scottish Seining in the Magdalen Islands

Near the Magdalen Islands, as elsewhere in Atlantic Canada, there are muddy/sandy areas suitable for the use of Scottish Seine fishing gear.

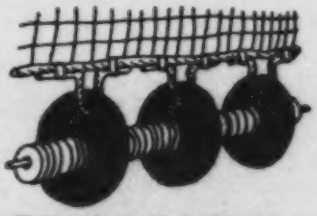
Demonstrations of Scottish seining were first offered to fishermen on the Magdalens by the Quebec Region in the fall of 1981. Following the Scotia Fundy Region's development of the self-hauling rope reel, requests came from fishermen in the Magdalens for AFDP support in equipping their vessels for this type of gear. Sea trials have been so successful that, this past year, a fisherman decided to diversify out of lobster fishing entirely and to specialize in Scottish seining, and it appears that others will now follow suit. By way of spinoff, this combined action by a number of fishermen will provide the basis for the re-introduction of groundfish processing on the Islands at an even larger scale than existed there historically.

Thus, Scottish seining is being promoted by 3 DFO Regions as an alternative to trawling for vessels less than 100 feet L.O.A. It consumes 50% less fuel than trawling and, in addition, improved quality of the catch is a recognized factor.

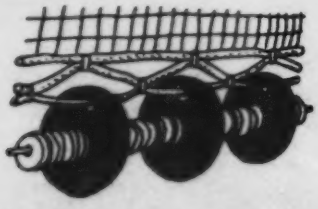
Rock Hopper Disc — Variations

The rigging of groundgear has changed from conventional "roller gear" (i.e. spherical bobbins or wheels) to what is termed Rockhopper footgear, using large diameter discs, usually 12-14 inches in diameter spaced out at intervals, with small discs (usually 4 inches in diameter) seized to the line to prevent movement. When this arrangement encounters bottom obstructions (such as rocks), it tends to "hop" over them, hence the name.

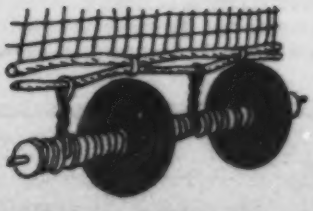
Three variations of Rockhopper ground-gear assembly



Fishing line with Rockhopper discs tied on spacing 1'-6" to 3'-6"



False fishing line woven through Rockhopper discs and attached to true fishing line with 'hand it' clips



Toggle chains with lanyards false fishing line through chains. Rockhopper discs tied to false fishing line

Trawl Door Investigations

Doors contribute as much as 30% of the total drag caused by gear. It is felt that hydrodynamically efficient doors can significantly reduce drag (resistance). Test tank evidence shows that contemporary bridles require a maximum angle of attack of about 32° to the direction of tow. It is common, however, for fishermen to strive for maximum spread. Work done in the Gulf Region using Bison doors has confirmed that this is detrimental to the tailored net configuration and reduces efficiency while increasing drag. Also, by disfiguring the trawl, it causes net damage. The dissemination of this information to the industry, adequately substantiated by video taped evidence, should be one of the most important components of any technology transfer program.

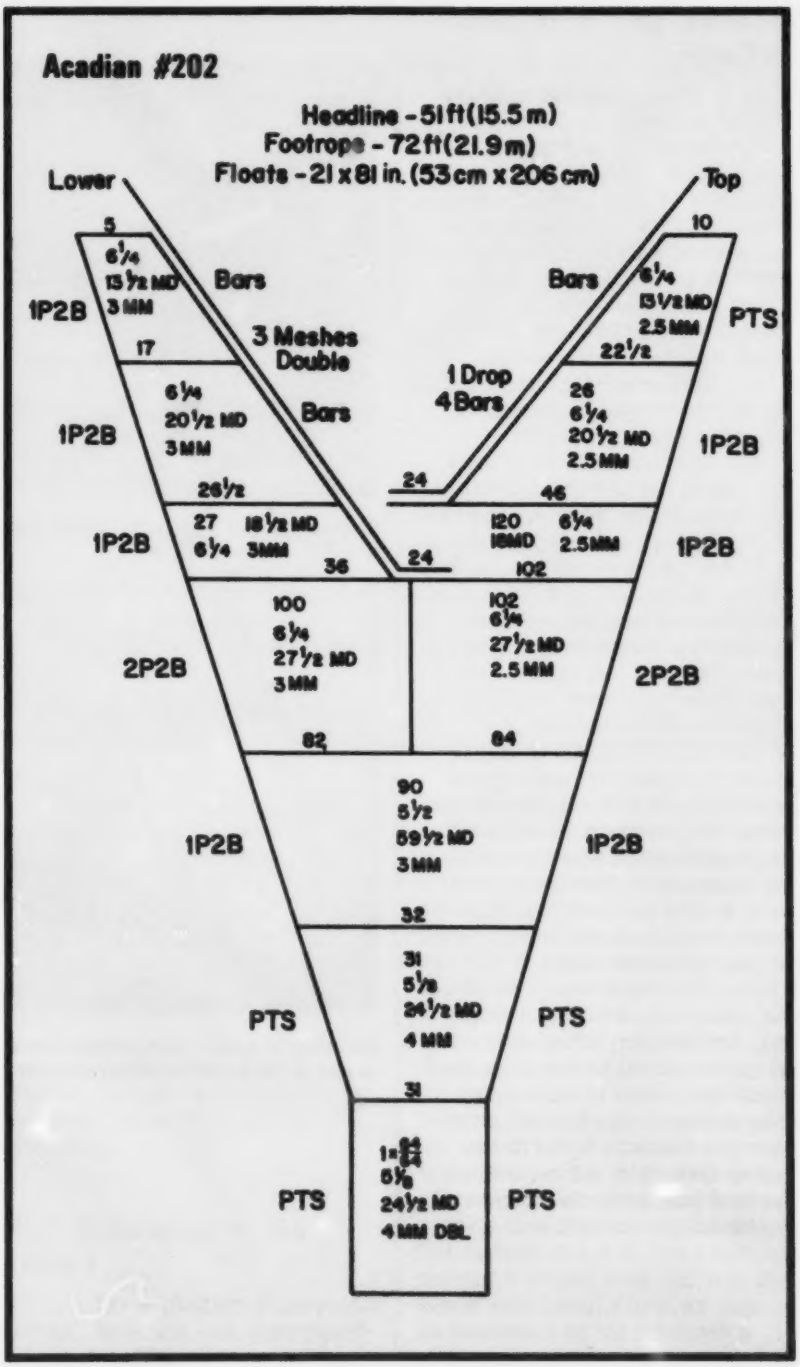
Acadian Trawl (#202) and Bison #2 Trawl Doors

Gulf Region has been instrumental recently in design and demonstration of the "Acadian Trawl" to be used by fishing vessels in the 45' LOA size range (140-170 H.P.).

The trawl was equipped with "rockhopper" footgear to permit improved performance over rough grounds. This type of footgear rarely gets tangled in the ocean bottom, reduces the amount of wear and tear on the trawl, and saves on tow time normally spent in trawl repair.

The Acadian #202 Trawl is very efficient. When used with Bison #2 Doors, drag is greatly reduced (hence lower fuel consumption). One of the fishermen involved in the project, for example, estimates that he saved almost $1500 in fuel costs because of the new trawl. In addition, it leads to a reduction of 200 RPM's during the operation of his engine and this should extend its operating lifespan considerably.

As a result of this work, several local fishermen have outfitted with a new trawl door combination; others have simply acquired a new trawl, as an interim step; and a large number have expressed interest in making a change in the near future.



Mackerel Gear Experiments in Quebec

Various experiments have been undertaken in recent years by the Quebec Region to determine which of four mackerel fishing methods should be used there. Recently, a fixed trap was set in Gaspé Bay; two stern trawlers were chartered to carry out semi-pelagic pair trawling; a 10.7-metre vessel was fitted for purse seining; and another inshore vessel tested a troll line system.

The semi-pelagic pair trawling method showed the greatest efficiency, with a total catch of 81,875 kg of mackerel. Purse seining trials in the Sept-Iles area have shown interesting results which promise accelerated development of this technique, aimed mainly at inshore vessels less than 13.75 m in length. The fixed trap installed at l'Anse-à-Brillant, near Gaspé, did not give the results expected. Among the problems encountered were: a scarcity of mackerel inside the Gulf of St. Lawrence, difficulties in learning to use the equipment, and a partial unfamiliarity with environmental conditions. However, the feeling is that this equipment does have potential; it has been used in Nova Scotia with some success and, with modifications, should prove itself under similar conditions near Gaspé.

The "bottom line" on all of this activity . . . following testing, and, depending on license availability, Québec should be able to produce a sufficient volume of mackerel by using mid-water trawling and purse seining techniques adapted to the inshore fleet. Work will continue on the fixed trap, while the troll line system has been abandoned.

Semi-pelagic pair trawler "LE BAROUDEUR" at dawn

Shooting the trawl – second vessel sea-keeping with "LE BAROUDEUR" to pick up the bridle (his half of the tow).

Knotless Netting

The actual netting material used in trawls is responsible for about 60% of total gear resistance. Through the use of knotless webbing, this resistance can be reduced by 20% (North Sea Centre flume tank experiments, Denmark). In 1986, braided knotless netting will be incorporated in a contemporary commercial trawl in order to demonstrate this potential to the industry. Subsequently, various mesh configurations, such as large meshes of light twine in the upper net panels and/or square meshes, will be inserted to further reduce resistance.

False Headlines/Color Panels (Otter Trawls)

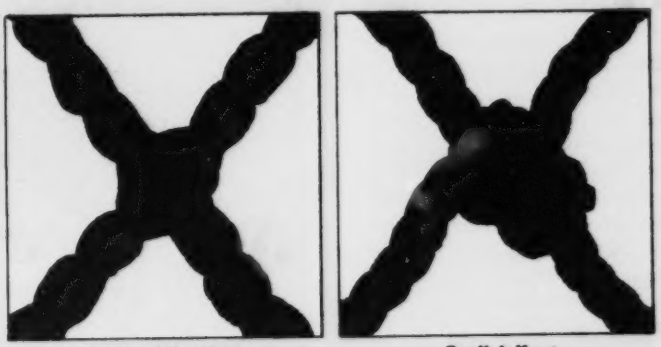
Underwater video/films of towed gear show that, at a certain point, fish swimming at the mouth of a trawl will rise and escape over the headline.

Bearing this in mind, a flying panel was designed by Scotia Fundy Region which would continue well ahead of the existing headline, fly considerably higher than it and be detachable for night fishing.

In 1985, underwater video and side-scan sonar observations showed that the panel could re-direct high-swimming demersal species into the mouth of the net. But these results must be considered preliminary.

Because it was so late in the season before work could get underway, it was decided to wait until the following spring/summer to validate the original results. Trials, then, will continue at the earliest possible time onboard a commercial fishing vessel. At this point, expectations are high.

Similarly, a project will be repeated to validate the effect of colour panels on fish behaviour in otter trawls and to thus take advantage of known behavioural characteristics of certain species in relation to bright and dark colours. A complete black section was constructed in a trawl which would appear to be an escape route to fish herded into the mouth of the net. Fluorescent streamers were mounted in the forward section. However, during trials in which an underwater camera was used, there were very few fish in the area and behaviour could not be observed. Again, plans are being made to replicate this work at a time when stocks are in greater abundance.



Twisted Knotless English Knot

Twisted Knotless Net is made of twine composed of two strands; each strand runs through the other to make meshes without making knots. This method of making nets was invented for Purse Seines and Trawls in Japan. It has certain advantages: the meshes are not distorted under strain, and, because it has no knots, there is a consequent saving of weight and bulk.

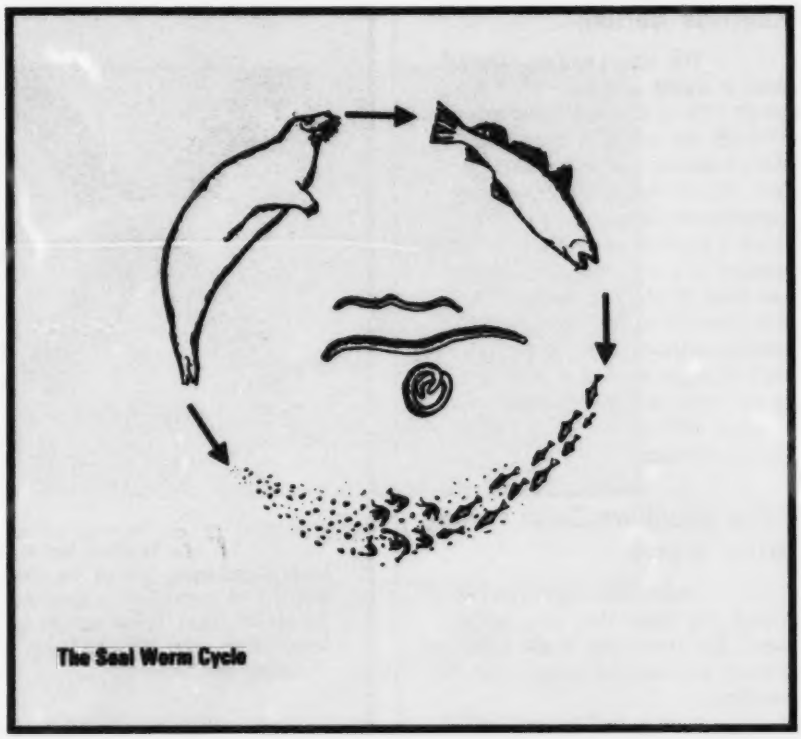
High Technology in the Fishery

The application of computer science, flume test tank experimentation, and underwater observations and data collection at sea are now "facts of life" in fisheries research and development. This important work can result in very sophisticated analysis of Canadian towed fishing gear. The application of advanced electronic equipment, particularly electro-acoustic fish finding and bottom discrimination technology, will also be an important area of interest. It will be invaluable in the design and deployment of gear and no doubt will contribute immeasurably to the conservation of fuel in the fishing industry. A conservative estimate of the savings which should accrue within five years is $13 million/year (given fairly widespread adoption and application of these developments). The payback period on these technologies is judged to be one year or less in each instance in which capital investment by the fisherman is required.

Parasite Detection and Removal

The problem of parasite infestation of groundfish on the Atlantic Coast continues to grow. Observations tend to demonstrate that the incidence of parasites has increased significantly in the past five years. It is no accident that Atlantic Working Group #3 has been created to co-ordinate efforts to come to grips with the problem.

The detection and removal of parasites cost the fish processing sector millions of dollars each year. The industry estimates that additional processing costs attributable to parasites could add up to approximately $30 million annually. If we add in the dollar value of various considerations that we have not yet been able to convert to monetary terms, such as the loss of income resulting from decreased quality, the risk of rejection of fish by consumers and the lack of development of new markets, that figure might even be greater.



The Seal Worm Cycle

Recent newspaper headlines attest to a growing public/industry awareness of the seriousness of the problem.

The Problem

Biological aspect:

Many different types of parasites are found in groundfish, however, most significant for the Canadian fishing industry are *Pseudoterranova (Phocanema) decipiens* and *Anisakis simplex*, both nematodes found in various groundfish fillets. Seals, primarily grey seals, are hosts to *P. decipiens*, while whales host the *A. simplex* nematode.

Processing aspect:

Removing parasites from fillets affects the economic viability of fish processing in three major ways: reduced yield, increased labour costs and lower quality in the final product (negative market impact).

Technological Alternatives

In view of the urgency of the situation and the desire to obtain conclusive results as soon as possible, the development of parasite detection and removal technology is being carried out in close cooperation with the industry.

Since 1983, the AFDP has included efforts to deal with the problem on three different levels:

1. *Improvement of existing methods and techniques*

   In-plant work has been underway to render existing techniques more cost-effective and more reliable in terms of product quality. This is necessary for two reasons: the results of studies on "futuristic" automated methods cannot be applied commercially for a number of years, and conventional methods are less costly and will, therefore, always be used (in plants where the level of processing does not justify the introduction of sophisticated methods and/or where groundfish processing is a secondary activity).

2. *Automated segregation of parasite-free fish fillets from those which contain parasites*

   It should be possible to automate the process used by the industry to separate parasite-free fillets from those which are infested. Uninfested fillets, even from fish caught in areas where there is a parasite problem, can be processed separately from the remainder of the raw material. This will result in a more intact product which can command a higher price in the marketplace.

Conventional Parasite Detection and Removal (Quebec)

3. *Automated detection and removal of parasites*

Parasites in the flesh of fish cannot yet be detected with available automated techniques. Therefore, a technique for detection must be developed and tested and an automated method of removing parasites with minimum damage to fillets should subsequently be developed.

The AFDP Approach

In order to solve the problem technologically, Quebec and Scotia Fundy Regions initiated projects in 1983 directed at improvement of existing methods and techniques and at automated detection of surface and inner-flesh parasites. In both cases, results are encouraging and, in the short term, it should be possible to achieve a more efficient, modified, conventional method of detection. The next phase of the strategy is more complicated – to further develop existing automated systems, systems which at present are not equal to the task. Systems of greater sophistication, utilizing visible and ultra violet light and ultra sound, must be able to detect parasites (surface and intramuscular), segregate infested from non-infested fish, and, ultimately, remove parasites from the flesh without human intervention. However, it will be several years before we are able to develop such systems, hence the need for the three tier strategy outlined above. We are, then, several years away from the day when fully-automated systems will detect infested fish, segregate it from the remainder of the catch, and remove parasite-infected portions.

For now, we have no alternative but to perfect existing methods of detection and removal, to conduct demonstration projects to ensure that the processing sector is up-to-date, and to continue with the work we have begun to develop future systems.

Fish Plant Production/Inspection Line (Candling)

Recently, an inter-departmental working group (DFO/DRIE/NRC) was set up to elaborate strategies and to identify and coordinate attempts to solve the problem. At the same time, a government/industry steering committee has been established to originate and direct these initiatives in accordance with industry needs and to ensure its involvement.

The Processing Sector

Processing is an area in which in recent years (with a few notable exceptions) involvement by the Department of Fisheries and Oceans has been generally curtailed. The AFDP, however, in addition to recent work in parasite detection and removal, has had some impact. One innovation with the potential to affect processing both ashore and at sea is a new machine-vision fish monitoring system being developed in Newfoundland.

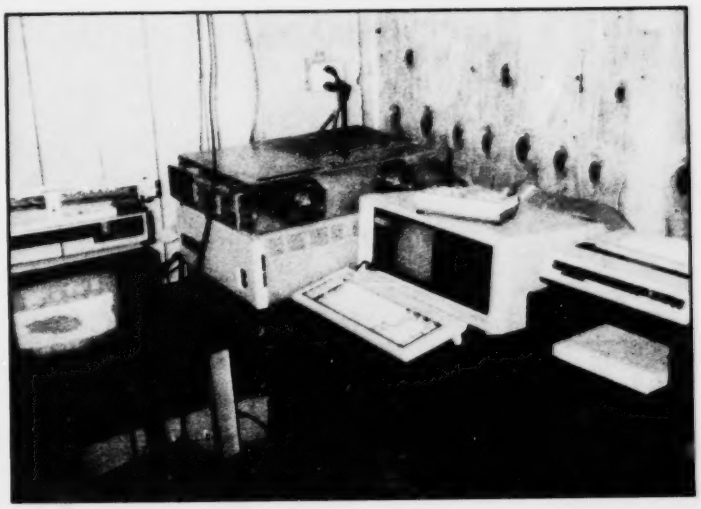
Fish Monitoring System

One factor influencing the efficiency of deepsea trawler and plant operations is the availability of real time raw material inventory data. If the processing sector had immediate and accurate knowledge of catch composition onboard trawlers, plant management would be in a position to gear up facilities and schedules to achieve maximum levels of efficiency.

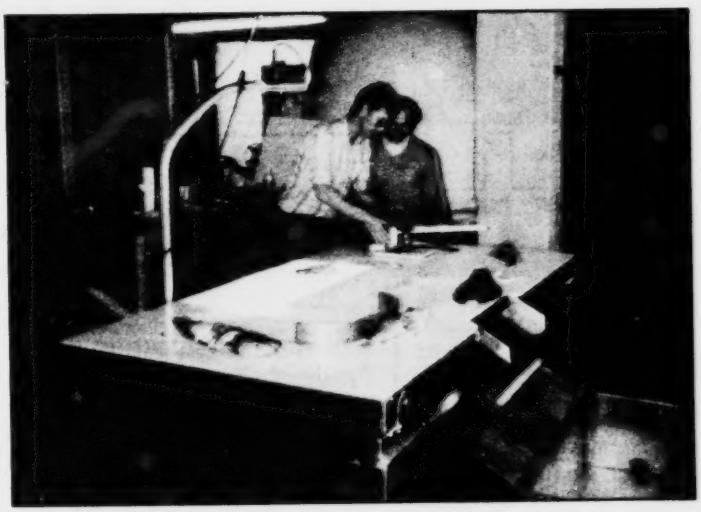
A St. John's consulting company, Grove Telecommunications, has been contracted to develop and test a prototype Onboard Fish Monitoring System. Grove, in turn, has sub-contracted with Octec of Boston, Massachussets to develop the EDP (computer) component. Octec is a high technology image-processing and machine-vision company

which specializes in the inspection and control of food and pharmaceutical products. They supply a complete system – computer, camera, monitor, output terminals and, of course, software. The program they have developed for this application can identify species by Algorithm from a combination of any of the following: aspect ratio, symmetry, nose angle, and/or tail type. The purpose is to identify, sort by size and species, and record fish by weight and number as they move by conveyor along a vessel's factory deck. This information is aggregated and can be transmitted (perhaps by satellite) – the Inmarsat System, for example) to shore where it can be used to redeploy the fleet and to facilitate production planning. With engine room and wheelhouse information already available, it is factory deck operations data which will round out expensive vessel management systems for the next generation of trawlers. If successful, it will provide the basis on which to build a large and more comprehensive system which, when combined with the Contrawl System (Pg. 67) would feed the following information to shore-based monitors by satellite:–

1.	Position of Vessel	Each Tow
2.	Weather	Twice Daily
3.	Catch to Ramp	Each Tow
4.	Catch Discarded	Each Tow
5.	Catch to Hold by Total Weight	Each Tow
6.	Catch Breakdown – Species and Size	Each Tow
7.	Position of Catch in Hold	Twice Daily
8.	Temperature of Hold	Daily
9.	Fuel Consumption	Daily
10.	Exhaust Temperatures	Daily



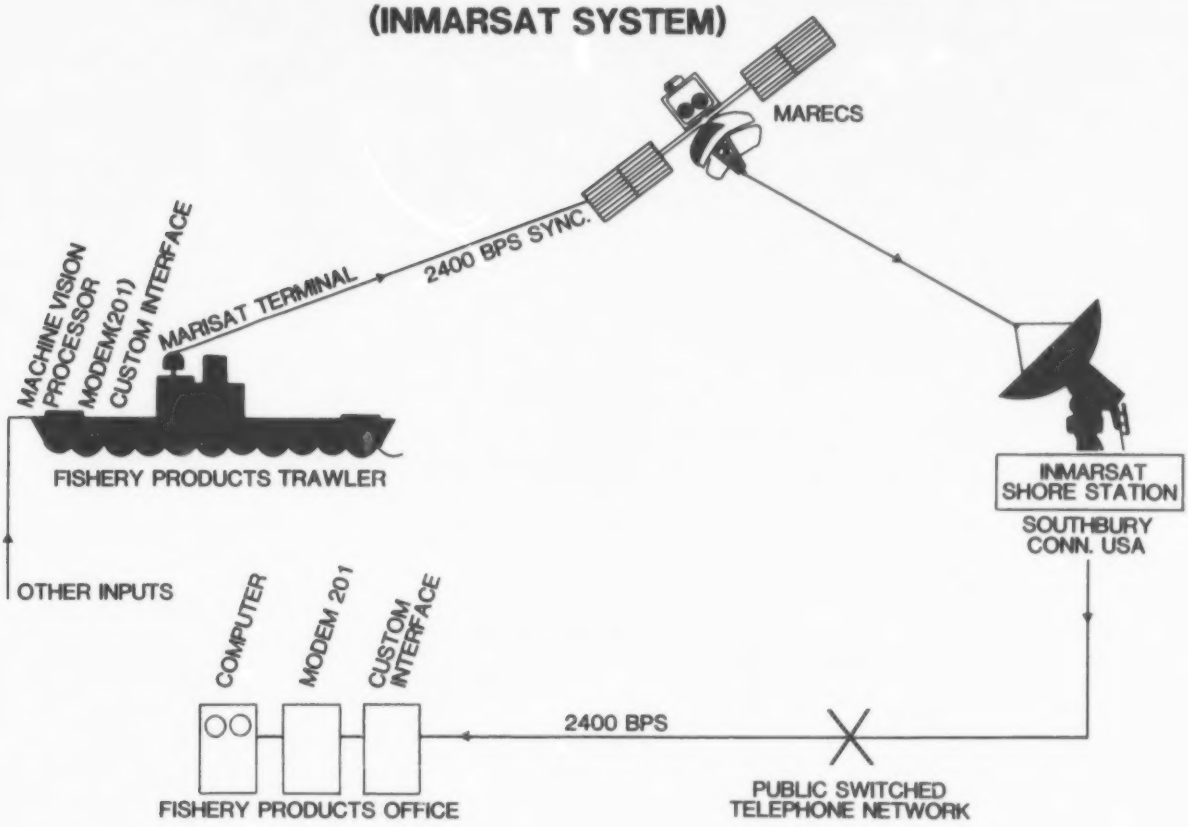
The complete EDP system includes a computer, camera, monitor, output terminals, printer and software.



Fish are moved along a conveyor belt (circular in this case) for image assessment by an electronic camera (mounted on a metal arm and positioned directly above the conveyor). This data is then processed by algorithm to determine species, length, and weight.

A Computerized Fish Operations Monitoring System

(INMARSAT SYSTEM)



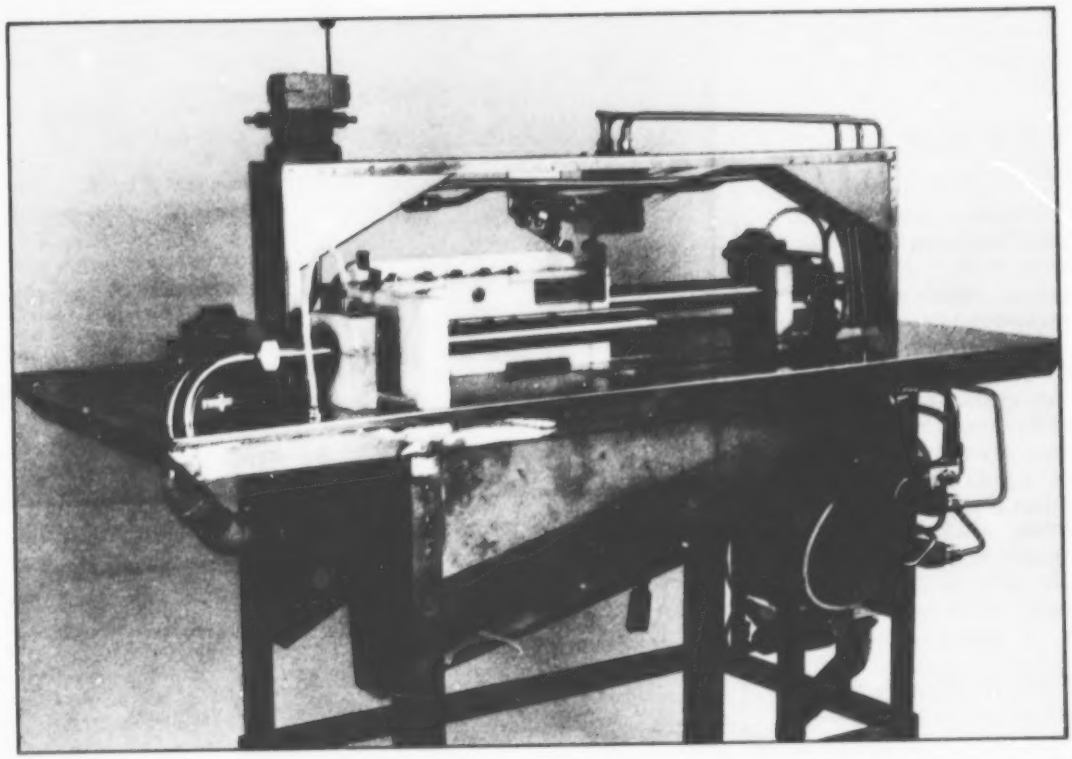
Applications for the fish monitoring component of the system also exist in DFO management/conservation/surveillance work, applications which it is estimated would save the Department up to one-third of its current rate of expenditure in these areas. In the processing sector, product sorting, grading, inspection and control applications would greatly improve operating efficiency and total yields. But if we can integrate the monitoring system described here into existing or future factory deck and communications systems onboard trawlers, we have made a quantum leap.

Industrial Engineering – Productivity Study

A major area of concern in the Newfoundland fish processing sector, as elsewhere, is productivity. NEWLANTIC GROUP, a St. John's consulting company was contracted in 1984 to undertake an extensive and detailed assessment of fish processing in Newfoundland and on the international scene. The objective was to identify, quantify and recommend areas with the potential to improve productivity in local industry. Such things as raw material parameters, cutting-line designs, trimming operations, machine/equipment layout/design and worker characteristics (physical) and their impact on productivity were addressed. The report argued that in Newfoundland alone the introduction of improved processing and management techniques could generate $60-$70 million additional income a year. Indications are, however, that the industry is independently moving on many of the innovations identified, (e.g. Program Application Ltd. is now working with FPI[1] and NSP[2] to introduce micro-computers and is helping to redesign the Highland Fisheries Plant in Cape Breton along appropriate lines).

The study has resulted in the creation, then, of a process whereby DFO will work with industry on an ongoing basis to achieve some of the efficiencies it has defined.

1. *Fishery Products International*
2. *National Sea Products*



Suction Gutter (Groundfish)

Suction Gutter (Groundfish) – Quebec

Gutters traditionally used by the Quebec fishing industry (and others) present certain problems. While adequate, they do not gut fish mechanically at the desired level of efficiency. With this in mind, the Quebec Region decided to develop a "suction" gutter, and a prototype model has been tested at a rate of 500 fish/hour. The target rate is 1000-1200 fish/hour to meet industry requirements, but this can be readily accomplished by rearranging the various components of the existing machine. Again, however, while acceptable, the quality of the work must be improved to meet the standards of the DFO Inspection Branch. Certain components of the gutting face will need to be changed in order to accomplish this. The feeling at the moment is that the simple addition of a new type of nozzle should resolve the problem so this is being done.

Fish Freshness Meter (Dockside Grading)

A high performance liquid chromatography (HPLC) method for determining ATP degradation in biological (fish) samples has been developed by Scotia Fundy Region.

Support for a better grading method has regularly been requested by field staff and fish buyers (whenever there is a dispute). The present technique whereby an officer simply gives a ruling can be time consuming and impractical. This project will result in an improved (more objective) inspection capability.

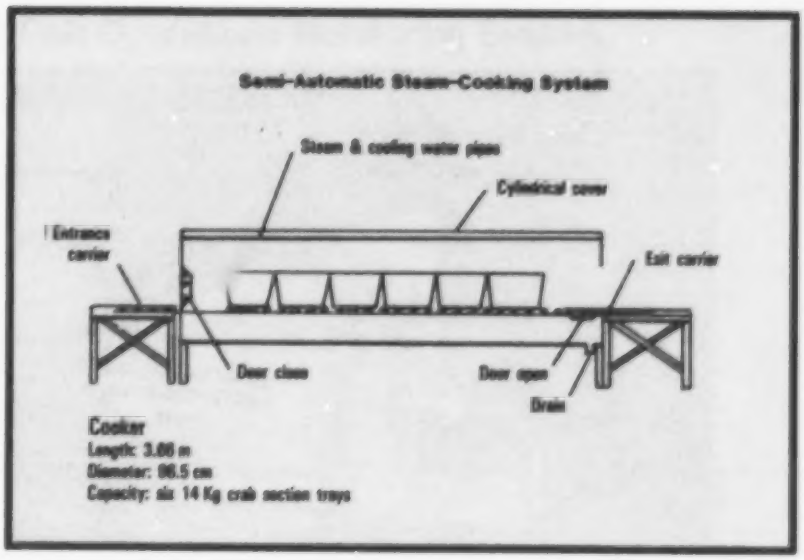
Based on ATP degradation in the post-mortem period, the degree of freshness can be determined by a newly developed lab-model fish meter (based on chemical changes). The cut-off data can be obtained within minutes by using a simplified instrument.

At the moment, plans call for the continued use of the lab-model fish meter to increase the number of measurements from groundfish and shellfish samples to confirm the methodology as well as to determine the effect of seasonal and other variations.

Co-laboratory testing and field evaluations are being conducted involving inspection staff, and a simpler instrument is to be designed and tested soon for routine grading operations.

Queen Crab Cooker – Quebec

Crab sections have always been cooked using sea water (usually followed by brining). It was suggested that steam cooking under pressure be considered to save time and energy, thereby reducing processing costs. Using steam spray, Quebec Region has established that crab sections can be cooked in 3 minutes, cooled, and emersed in brine. This represents a more efficient processing method than either batch or continuous cooking, which use boiling water. Quality, texture and taste remain the same, while meat extrusion is easier and weight loss is reduced. The equipment can also process lobster, shrimp and other shellfish. An operational prototype is now available and is being tested on a commercial basis. But comparitive studies between the prototype and traditional methods and equipment are expected to take some time.



QUALITY (VALUE) ENHANCEMENT

Objective: To enhance the Value of the Commercially Harvestable Resource through Quality Improvement and Product Development Initiatives –

to maximize revenue at each stage of the production-consumption cycle toensure that innovative, diversified products of consistently high qualityare available to effectively meet market demand.

Everyone involved in the fishing industry at last seems to realize that one most important ingredient in ensuring that this country will have a stable and viable fishery is the consistent delivery of high quality products to the marketplace.

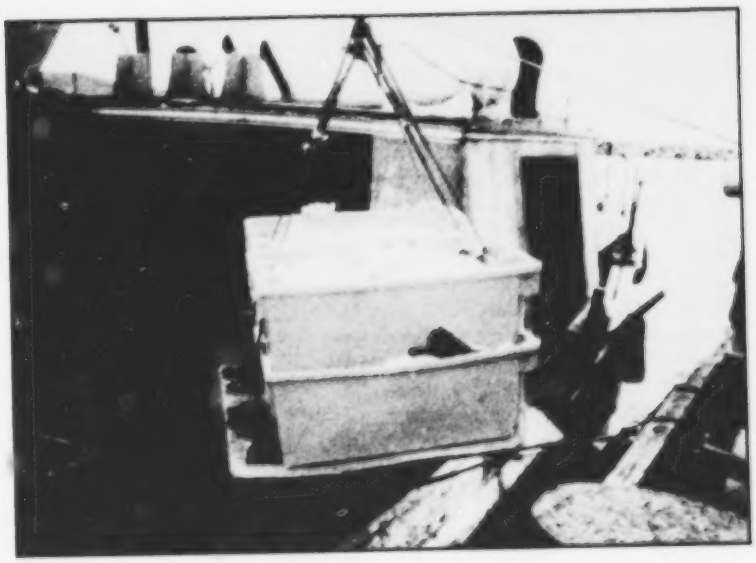
During the past five years or so, several factors have contributed to this greater concern for quality:

- the price of fish has escalated substantially,
- fish content, as a component of total product cost, has increased,
- there is a much larger price differential between blocks and prime fillet packs, and
- firmness and wholeness of fillets has become a major quality/price determinant.

One role of the AFDP is to assist fishermen and processors to meet or exceed established quality standards through the development, improvement and/or demonstration of gear, equipment and methods to maintain the quality of fish from the time it is taken until it is marketed. Improved quality will result not only in products of greater value, but also in reduced processing costs and waste. The objective would be to capture our fair share of the lucrative international restaurant and premium-grade processed fish market, the "high end" of the market long dominated by Iceland and the Scandinavian countries.

As we have already pointed out, annual losses in total groundfish market revenues of as much as $50 million/year are attributable to quality problems. If the Europeans can produce a quality product with an, arguably, poorer resource, there is no reason we cannot continue to improve the quality of ours.

The resource available in Eastern Canada offers tremendous potential for new and/or dramatically altered products, i.e. both product development and product innovation. The successful development of new products would provide increased utilization of the resource and increased employment in the processing sector. Increasing the yields from existing production and creating a more diversified range of products translate directly as "value-added". With fish prices already quite high in our major export market (the United States) and demand remaining fairly steady, this may be the only viable strategy available to us in the short run which can radically improve profit margins in the industry.



A basic form of container is the plastic box. This type, being used in Newfoundland, is similar to those used throughout Atlantic Canada.

Onboard Fish Handling, Holding and Offloading

The whole area of the handling, holding and offloading of fish (inshore and offshore) was deemed to be so important in terms of product quality that a fourth Atlantic Working Group was established to deal with it in June, 1985. These three elements are so closely interwoven and offer development opportunities to such varying degrees from fishery to fishery that a systems approach was adopted. It was also agreed that containerization, an important component of such an approach, should be understood to include both plastic tote boxes and insulated containers of various types.

Background

While acknowledging valid complaints voiced in certain quarters at certain times, it must be said that Canadian fish products, for the most part, are of acceptable quality. They do not, unfortunately, enjoy the status possessed by some competing products in the international marketplace. Canadian products have been cited as being of "differing and inconsistent quality and texture". The result is that they consistently undersell themselves as buyers build in contingency margins. It is important to point out, however, that quality is improving; progress has been and is being made, and that additional work needs to be done to raise standards.

The reasons for this traditional shortfall have included a lack of thorough in-plant quality control and the absence of regulated grade standards. These considerations can be clearly attributed to the processing sector. It, however, cannot improve

the intrinsic quality of the raw material, the fish arriving at the plant loading door. The "quality problem" begins as soon as the fish is taken, as a function of the gear and how it is used. In addition, too often, fish are not properly handled and stowed aboard vessels in Atlantic Canada.

At the present time, the large, vertically-integrated companies are able to realize increased profits through improved standards and have been steadily moving to onboard systems which improve the landed quality of fish taken by their trawlers. The independent fishermen, however, with few notable expectations, have no such incentive. In order to increase their profits, they can only increase landings and/or reduce operating costs. This places quality considerations lower on their list of priorities.

The Atlantic Working Group on Onboard Handling, Holding and Offloading was formed to co-ordinate a strategy to address the quality problem in comprehensive fashion. It has established firm targets for both the integrated operations and the independents.

Company-Owned Offshore Vessels

It is considered reasonable to target a 10% overall improvement in market value due to enhanced onboard fish handling, holding and offloading systems for offshore vessels. The net benefit of containerizing fish offshore is anticipated to be in the order of 19%. Experimental data to date tends to support this projection.

Investigations and observations aboard offshore trawlers have revealed that productivity improvements in the order of 20% – 60% are also achievable if fish handling systems are properly engineered using sound ergonomic design principals and if the handling process is mechanized to the greatest extent possible.

The NSP operation in Louisbourg, N.S. is experiencing great success (a high quality raw material) using the European 90 litre box (container)

Independently Owned Vessels

It is rather difficult to target a level of improvement here because the most significant factor to encourage the introduction of a successful system is not yet in place – a price differential based on intrinsic quality.

The AFDP strategy, therefore, has been:

(1) to encourage a dockside price differential based on quality and to support end-of-line grade standards so that both fishermen and processors will be able to reap the market benefits of improved quality, and

(2) to develop onboard fish handling, holding and offloading systems and related technology to enhance quality and to improve productivity.

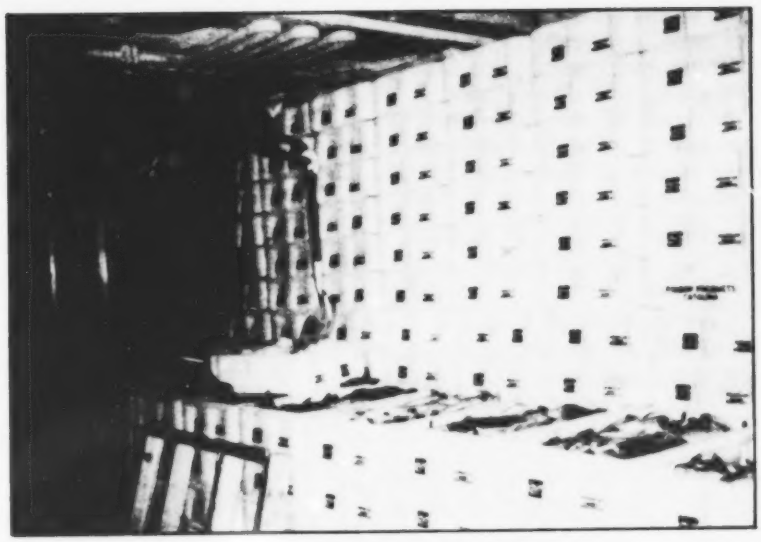
Containers (Offshore)

DFO is confident, that there are very real benefits to be obtained through containerization.

The European Box System

Scotia-Fundy Region demonstrated successfully the use of 70 and 90 litre boxes on offshore trawlers in 1980-81 and work continued in the years that followed. As a result, it looks as though the ***European Box System*** has carried the day in Nova Scotia and some operations in Newfoundland, with National Sea Products in the process of converting many of its existing trawlers to this system.

Fishery Products International, on the other hand, also continues to experiment, with AFDP assistance, on the Contrawl system.



Stromberg 90-litre boxes in use onboard the Fishery Products Stern Trawler *Zamberg* (53 m). The *Zamberg* was built in Marystown, Newfoundland, in 1981.

The Contrawl System is a mechanized onboard handling system designed to minimize the negative effects of onboard handling on fish quality, to improve working conditions onboard and to provide for rapid unloading and vessel turnaround. With Contrawl, there is no requirement to have men in the fish-hold. Containers are filled with ice and fish (2,000 lbs at a time) on the factory deck and mechanically transferred to the hold for storage. The operation is reversed for unloading when the vessel arrives in port.

Development of the system is a joint undertaking of Contrawl Ltd., Fishery Products International Ltd. (FPI), Fisheries and Oceans (DFO) and the Department of Supply and Services (DSS). DFO and DSS have provided the major share of the funding. FPI has absorbed the costs of vessel downtime associated with installation and testing, while Contrawl Ltd. did the design work and supervised installation.

A prototype system has been installed in the forward hold of the M/V *Atlantic Maragret* a 153' stern trawler operating out of Marystown, Newfoundland. To date, the vessel has made several trips of approximately 10 days duration each. There have been some minor problems with icing, container alignment, etc., but no major difficulties have been encountered. In all cases, the system has met or exceeded expectations.

At present, production data is available for the first two trips only. In each case, the first fish caught (oldest fish) was stored in the containers. Results are similar to those achieved in other boxing experiments conducted elsewhere at other times.

(1) Eight to ten day old containerized Contrawl fish (primarily cod) produced 60% to 67% premium pack versus 35% to 40% for penned fish of similar age.

(2) Work content (trimming) on Contrawl fish was 7% to 10% lower than on penned fish.

(3) Final yield on Contrawl cod was 2% to 4% higher than on penned fish.

(4) It is too early, at this point, to get conclusive data with respect to cutter and trimmer performance. However, indications are that its impact here will be positive as well.

System testing and trouble shooting continued throughout the winter. It is now apparent that future work will be required in the following areas:

(1) Vessel/dock interface (loading/offloading containers),

(2) Onboard icing,

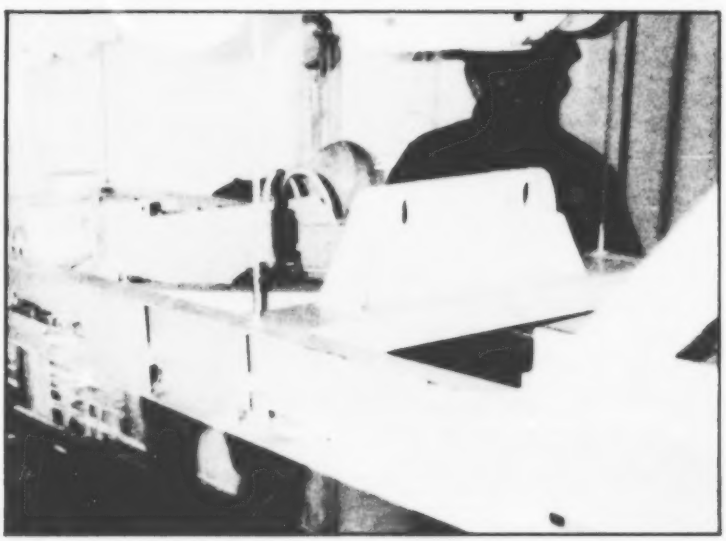
(3) An in-plant container handling system, and

(4) The testing of a complete system and interface components.

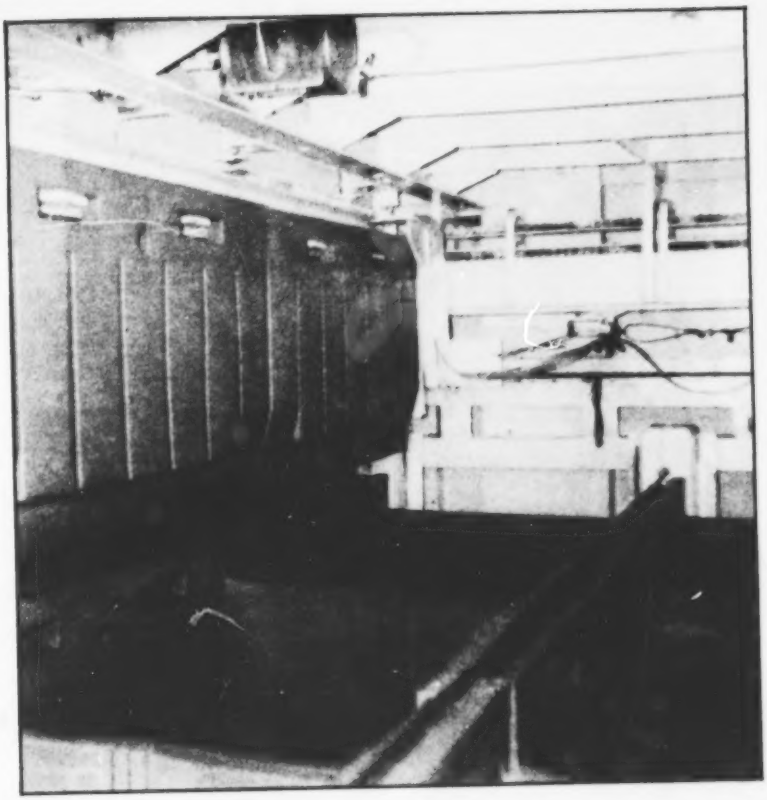
The company feels that the Contrawl System has tremendous potential. It is easy to envisage the projected increase in annual landings, a result of reduced in-port turnaround times, and a level of raw material quality comparable to that of conventional boxing systems. Then too, the age of the FPI fleet is now thirteen

The Contrawl System

Atlantic Class stern trawler Atlantic Margaret, 153' LOA, owned and operated by FPI, undergoing refit and installation of the Contrawl System at the Burin Refit Centre in Newfoundland.



An in-hold view of the travelling bridge and its set of three containers. These can be both manipulated and stored in the fishhold.



Forty-eight 460-litre boxes can be manipulated and stored in the forward hold of the Atlantic Margaret. This is done completely automatically after the containers leave the factory deck.

years. When you consider this, in combination with projected growth rates in Atlantic groundfish stocks over the next five years, you begin to understand that there will have to be a major fleet replacement program in place within that time. There is now almost total agreement within the industry that this new generation of ships must be containerized, the only issue which remains is the type of system to be used. At $14 million in total cost per vessel, we had best be certain on that point . . . . before we proceed! And again, the projected cost of operating trawlers using conventional systems is $2.5 million per vessel/year, but the designers of the Contrawl System claim a combined impact on vessel operations of around a million dollars a year. Even if overstated by as much as 50%, this kind of reduction in operating cost and/or increase in revenue, spread across a fleet of 56 vessels, cannot help but have a tremendous effect on a company's "bottom line".

It also is reasonable to assume that similar benefits are achievable through containerization in other fleet sectors. It is unclear, however, whether the benefits are sufficient, on their own, to justify the conversion of the inshore fleet to boxes. Other aspects, such as turnaround times and ease of unloading may be more important considerations. Again, however, the AFDP must continue to seek out the answers to these questions so that whatever conclusions are reached and whatever decisions are made are based on scientific fact and are not merely a matter of opinion.

Handling Procedures on Inshore Fishing Vessels

There are in excess of 29,000 inshore fishing vessels in Atlantic Canada. This number includes many types and sizes of vessel from 18 to 65 feet. They are constructed primarily of wood and fish a wide variety of gear. The length of the trips they make ranges from several hours to several days.

Fish handling practices vary with the type and size of vessel and the type of operation. Materials and methods which work well for some fishermen may not be practical for others. Otter trawl operations differ from gillnetting, as do trapboat operations from longline operations. Each technique requires unique, but sound, handling procedures and equipment if landed fish quality and the prospects for viability of the individual enterprise are to be improved.

In 1982 and 1983, the Newfoundland Region began to investigate ways and means to improve fish handling and storage methods onboard inshore fishing vessels in the province. The problem was approached in several different ways:

(1) How best to improve quality,

(2) How to meet the proposed new inspection regulations with minimum cost,

(3) How to make the work easier for fishermen, both at sea and during unloading at dockside, and

(4) How to reduce the overall cost of icing and handling.

The container or box seemed to address all of these concerns. However, due to the numerous shapes and sizes of vessel, it proved virtually impossible to have a single, standard box size or shape. A series of alternatives, then, was evaluated.

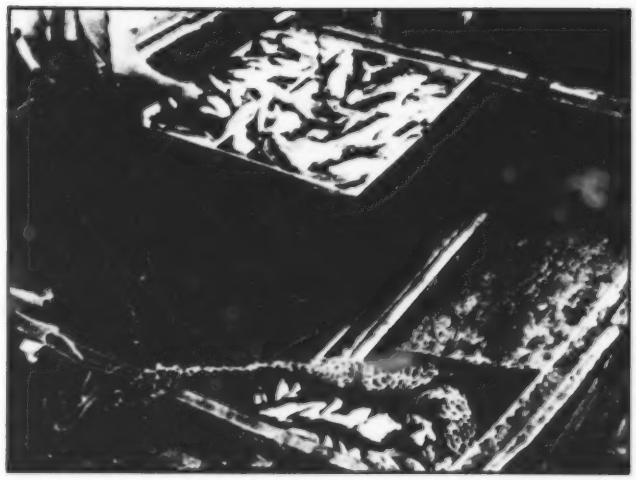
Trapboat Containerization

The trap is one of the most labour- and cost-efficient methods ever designed for cod fishing. Developed in the 1860's by a fishing skipper, the use of this type of fixed gear has spread over much of the Newfoundland/Labrador and the Quebec north shore. Improvements have been made to the original design and traps for capelin, squid, mackerel, and herring have also been successfully developed.

The cod trap season in Newfoundland is short and usually runs for a 6-10 week period (May to August), depending on the inshore migration of codfish. Seasons vary from area to area, usually beginning in late May or early June, peaking in June or July, and fading again in August.

Landings often exceed the processing capability of plants located in areas experiencing a good trap fishery, especially during peak season. This occurrence, commonly called the "glut", usually results in a situation in which fish must be held over for several days before processing. In many cases, fish are iced and transported via truck to other plants. The numerous handlings, movement of the fish, and time involved tends to lower the quality of both the raw material and the end product.

It was decided that an inexpensive system possessing durability, good insulating properties, and the capability to accommodate average daily catches would be needed. And so, containers were constructed of aluminum and contoured to the shape of the vessels. They have a capacity of seven hundred and twenty pounds (round fish) and each container has hoist-out attachments for offloading. Forklift capability for transportation to the plant and non-skid covers were included which, in addition to protecting the catch, formed a working deck.



Molded Container Inshore Vessel

A review of the project clearly indicated that the high cost of a custom-made aluminum containerization system was a major deterrent to acceptance by fishermen. The developer nevertheless continued efforts to design and manufacture insulated, rotational-molded, container kits adaptable to most open fishing boats. Such a system would be much cheaper and have greater insulating properties, while maintaining desired levels of durability. Again, however,without a quality price differential, widespread application is out of the question.

Open Boat Containerization

During the summer of 1983, a number of Newfoundland fishermen were asked to experiment with a 9 cubic foot insulated container which has a carrying capacity of 450 pounds of iced fish (purchased off-the-shelf for approximately $280). Each unit measures 43" × 22" × 28" outside (36" x 19.5" x 22" inside) and comes with an insulated cover. Response to this size of container was quite positive for the following reasons:

(a) It could be used in boats as small as 18 feet;

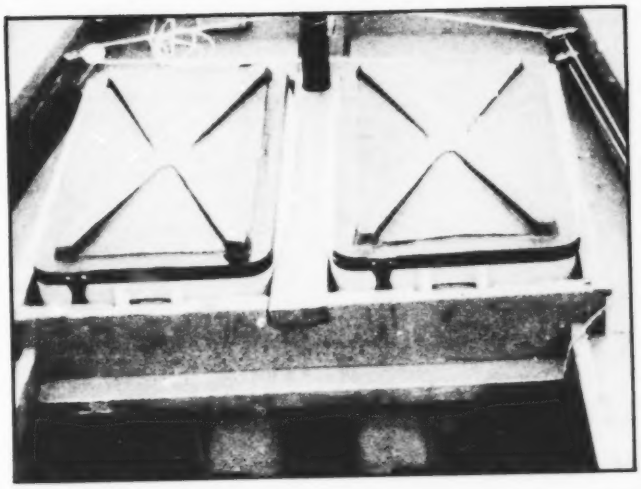
(b) It could double as a wash box;

(c) It permitted fishermen to take ice to the fishing grounds in small open boats;

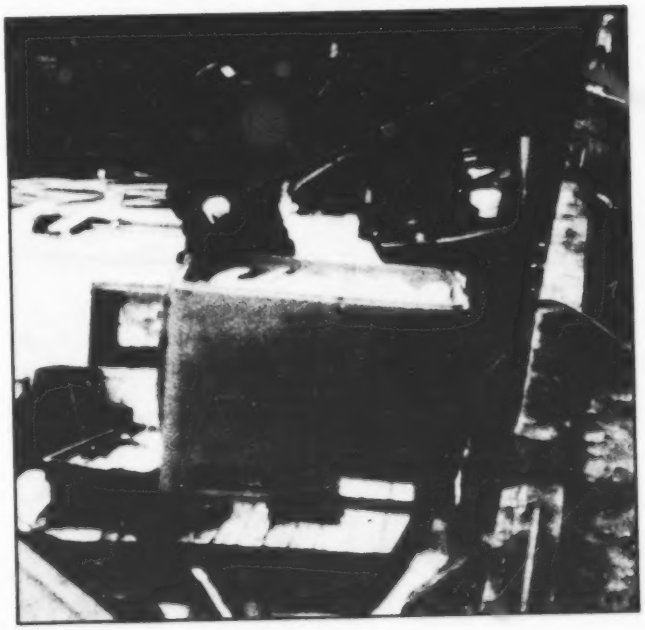
(d) The need for ice was reduced by two-thirds because of insulation; and

(e) It provided for ease of unloading.

While most fishermen felt that they could better utilize the space on their small boats with a different design of container, they felt is was a major improvement over holding fish in bulk.



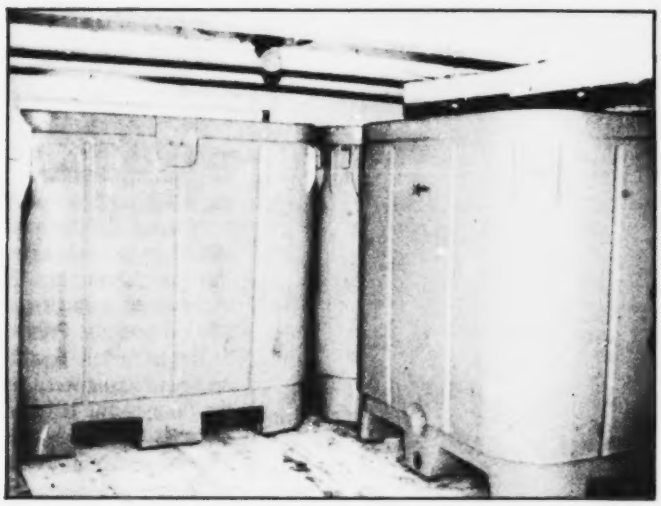
Each of these containers can hold approximately 450 lbs. of round cod, can be moved with ease (note the fork lift adapters on the bottom), and has drainage holes which allow the catch to drain on board.



Containerization — Inshore Decked Vessels

In 1983, the Newfoundland Region installed 14 insulated fish containers onboard a 55 foot gillnetter. Eleven containers, each measuring 44"L x 43"W x 46.5"H with a capacity of 2000 pounds, were placed in the hold. The remaining three units were put on deck to give a combined container capacity of 28,000 pounds. Prior to installation of the units, all existing stanchions and penboards were removed and the floor of the hold was raised 8 inches to provide a level and smooth surface on which to place and manoeuver the containers. Manholes were installed to provide access to those containers not accessible through the hatch opening.

The crew of the vessel using the containers throughout the 1983 season were more than satisfied with the resulting positive affects on fish handling. Due to the fact that the vessel was not landing under any dockside grading program, however, no evaluation of the impact of this procedure on fish quality was attempted. But containers were unloaded in less than fifty percent of the time it would have taken to unload fish held in bulk (pens). Also, it is reasonable to assume that reduced handling would reflect positively on the quality of both landed and processed fish.



These 2,000 lb. capacity Insulated Containers placed in the hold provide quality fish storage and easy off-loading.

Containers Offer a Practical Alternative to Net Bags and Fish Hold Insulation.

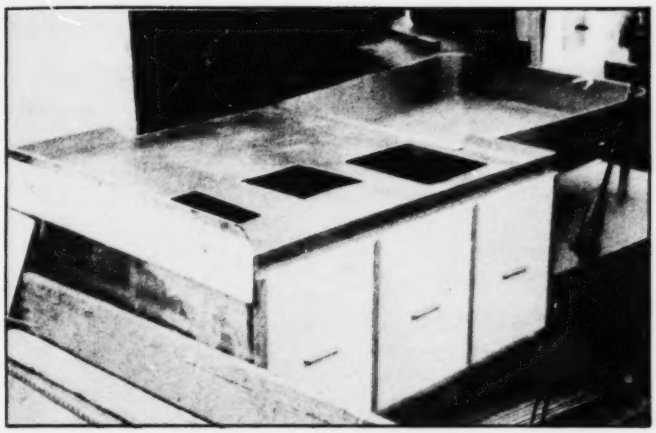
Onboard Handling System

In 1982, Newfoundland Region designed a three-compartment tank for gutting, bleeding and washing fish onboard inshore gillnet vessels.

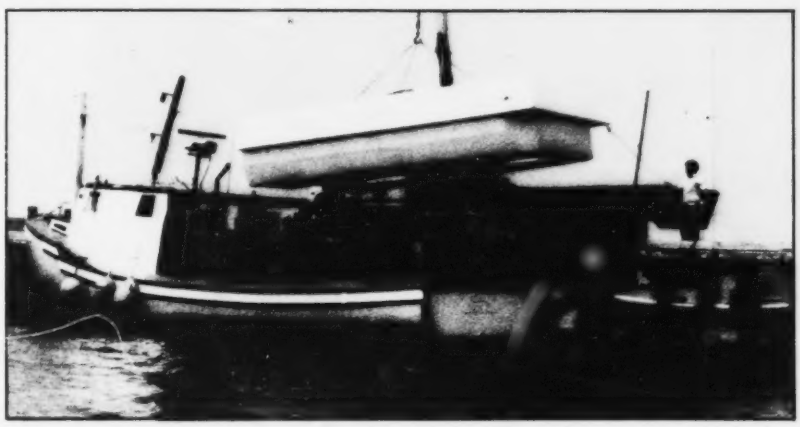
The handling system shown here can accommodate three different species – cod, turbot, flounder. It is comprised of a fish holding ramp; a wash/bleeding tank, which also serves as a table on which to cut fish; a cod bleeding tank; drainage chute; a manhole with cover; and plastic fish boxes stored in the hold. The system is designed to afford fishermen the opportunity to bleed, gut, wash and ice at sea.

The onboard handling system is positioned on the port side of the vessel, between the hatch combing and bulwarks. The detachable drainage chute extends through the vessel hatch or into a manhole. As the fish are retrieved from the gear, they are placed in the holding ramp. From here, a crew member picks each fish up, bobtails and guts it, and places it in the appropriate compartment of the washtank. When one or all compartments are full, the door in each is raised allowing the fish to flow out of the tank onto a sloped drainage chute, where they are held for a minute or two to drain. Then a manhole cover in the deck is opened allowing the fish to slide down to the hold into pre-iced plastic boxes. Additional ice is placed throughout the fish in each box stacked in the hold. These externally drained boxes hold approximately 40 kilograms (ninety pounds) of iced fish.

The system has proven, in the intervening years, to be a very effective method of ensuring high quality landed raw material. It too, however, has not enjoyed widespread adoption because of the lack of price differential based on quality.



Compact Handling Systems – Inshore Vessel



Fibreglass Fishhold Insert – Prototype

On-Deck view of a second insert prototype (inshore vessel), Caraquet, N.B.

Inshore-Midshore Fishhold Liners and Inserts

In the Gulf Region, several initiatives have been aimed at improving handling and holding systems on inshore – midshore vessels. These include the fibreglass Fishhold Insert (several prototypes) and fishhold liners using fibreglass and high density polyethylene.

In some cases, fishermen have been involved in the design process. These projects are ongoing in that DFO is closely monitoring the performance of these units as they affect quality.

As a result of AFDP demonstrations, some fishermen in the Gulf and Quebec Regions have decided to use similar units on their vessels, especially when fishing groundfish and herring.

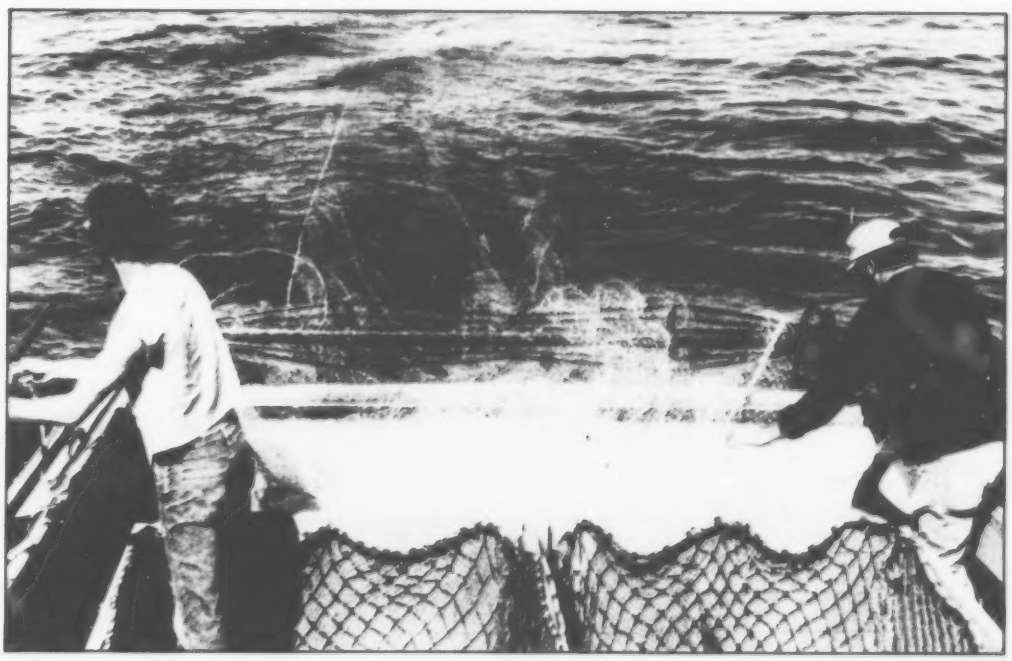
Handling Improvements in the Herring Fishery

The herring fishery is an important sector of the Atlantic fishing industry. In the last five years, annual landings by the Bay of Fundy fleet have averaged 100,000 tonnes, worth some $60 million.

Purse seiners use refrigerated sea water or ice and generate good quality fish. Gillnetters (lobster boats) have traditionally used pens, (no ice). DFO has recently introduced new harvesting and holding systems to Southwest Nova Scotia,as well as new dockside unloading equipment to help raise product quality.

With the gillnet fleet, Scotia Fundy project engineers modified commonly-used steel net rollers at the stern of the herring boats by welding spindles to them. Spindles spread the nets evenly and reduce damage caused by the rollers as the fish are hauled aboard.

Traditional Pen System



Modified roller (using steel spindle) at stern of a gillnetter

Courtesy of "The Sou'wester", Yarmouth, N.S.

Spindle roller and net bags (set in insulated boxes) *Courtesy of "The Sou'wester" Yarmouth, N.S.*

Herring being unloaded using the net bag system (Shippagan, New Brunswick) – A one step operation

Two other procedures, a shaker mechanism and net unloading bags, demonstrated an improved product quality and higher unloading rates. By installing a spindle roller, shaker and insulated boxes at a total cost of $4,000, good quality herring was landed and a higher price paid to each vessel. It was felt, however, that a vessel owner could improve his quality with even smaller capital outlay ($300) by installing only the spindle roller and net bags, while ensuring adequate icing of the herring caught on each set.

In May, 1985, a proposal was submitted to DFO, Scotia Fundy by the Maritime Fishermen's Union to incorporate these designs into an improved handling system for gillnet vessels. Unloading nets (net bags)

are used by these vessels for both domestic and foreign sales to eliminate the slow, tedious and damaging process of shovelling fish into buckets. By installing high capacity (1000 lb.) cranes at dockside in Yarmouth and Cape St. Mary's, Nova Scotia herring was unloaded into wash tanks, ensuring as well an adequately washed product for domestic markets.

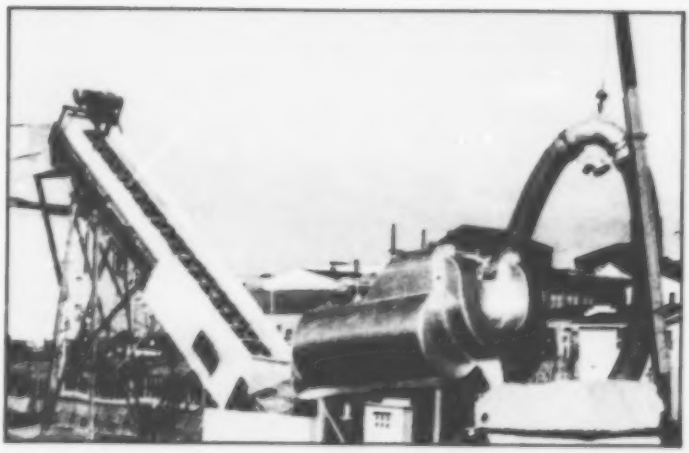
A similar concept has been introduced into the Gulf Region as well. During the 1984 herring season, DFO in northeastern New Brunswick, carried out tests on this system in collaboration with Connors Bros. Ltd. and an inshore herring fisherman. During trials, the proportion of herring that could be packed whole was higher for herring unloaded in net bags. Roe yields, while not measured empirically during the tests, also appear to have increased.

Herring Pumps

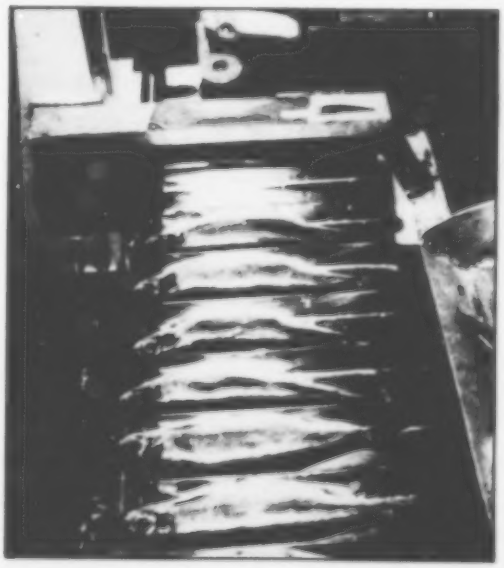
With the seiner fleet, advanced pumping techniques for loading and unloading have also been investigated. The Karm pump, a 14" diameter Norwegian submersible pump, complete with de-watering system, was tested by DFO in 1983. A definite rise in the quality of the fish was noted. However, at the time, the capital outlay could not be justified because of a lack of available markets.

In the spring of 1984, however, the Atlantic Herring Fishermen's Co-op in Yarmouth, N.S. approached DFO for assistance in evaluating a new liquid pump for unloading seiners at dockside. The Transvaac Pump Model 2020 was designed to work in areas of extreme tidal rise and fall (like the Fundy area) and it demonstrated a dramatic improvement in unloading capability.

Impressed by the obvious advantages of Transvaac Model 2020, DFO is considering its application in the groundfish sector as well.



Transvaac herring pump original model 1010, forerunner of the 2020

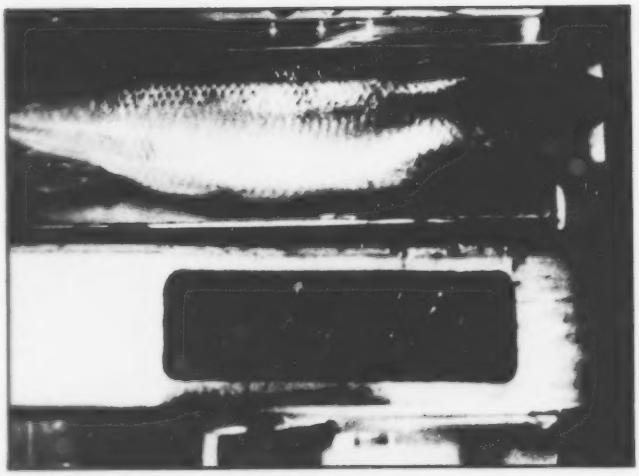


Herring placement or Sex Sorting Machine – in Pockets

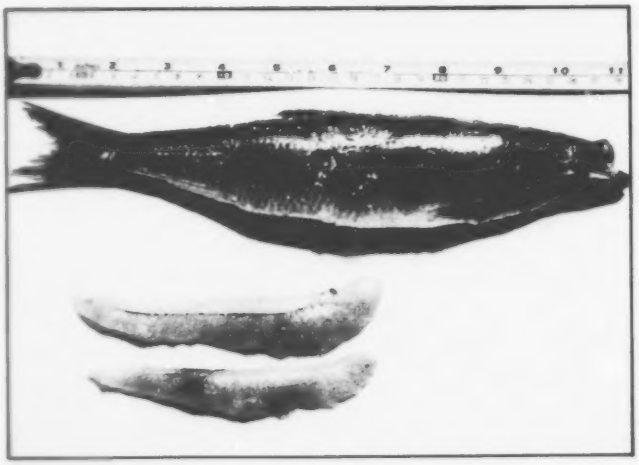
Since the early 1980's when Japan began turning to Atlantic Canada for supplies of roe for its home market, our herring fishery has become almost exclusively a roe fishery. Preliminary figures for 1985 indicate that nearly four thousand tonnes of herring roe were extracted and frozen in southwestern Nova Scotian processing plants bringing an estimated revenue of over $27 million to the industry. Fishermen were paid an average of $160 per tonne of herring sold for roe extraction.

The present method of extraction is only half as efficient as it could be. The problem stems from the fact that, to the naked eye, roe-bearing females are almost indistinguishable from males. This means that all herring, both male and female, must be split manually (on cutting tables) to determine their sex. The valuable roe sacks are removed from the females, but the damaged bodies of the male are discarded as unfit for further processing. In fact, some fifty thousand tonnes of herring was dumped in 1985, with processors paying up to $20 per tonne to have the carcasses hauled away for disposal. Apart from the inefficiency, this waste represents a loss of potential employment and economic benefit to the industry.

In the summer of 1985, Scotia Fundy Region initiated a study to examine the effectiveness of a machine that could differentiate female from male herring. This "sex sorting" machine had earlier proven effective with Pacific herring. Trials were conducted in Nova Scotia at the Comeau Seafoods plant in Pubnico. Belly-up fish pass through the machine one at a time. A light, beamed into each fish, is used to distinguish males from females and the machine directs each into the appropriate processing channel. It is 95% accurate and can handle three tonnes an hour.



View showing light transmission through Male Herring properly positioned for source and sensor



Typical East Coast female herring at full maturity showing roe to body proportions

The AFDP accepts the urgent need to find additional uses for herring and is exploring several avenues for converting herring into attractive food products. Pickled and smoked products are economical possibilities, as is the use of herring for surimi.

Over-the-side Sales Scale

The AFDP also includes projects to improve herring quota management of over-the-side sales (OSS). OSS allows the sale of herring to foreign vessels when domestic plants lack markets. The allowable quota under the program is monitored using international conversion methods to determine the weight in tonnes of herring corresponding to a fixed volume of fish.

The conversion factor used in the international method varies depending on the species and the geographic location in question. Under the OSS Program, DFO helped adjust the standard in Canada's favor, increasing it from 864 kilograms to 920 kilograms per cubic meter in 1985. This change translates into a 6% increase in the accuracy of quota monitoring under the OSS program.

Monitoring of domestic herring landings has also been improved over the last two years through the introduction of mobile truck weigh scales. These portable platform scales, similar in design to stationary highway scales, have been demonstrated to have an accuracy of $\pm 1\%$. Compared to traditional methods of estimating volumes and conversion factors, they provide a more accurate, legally-verifiable weight for improved monitoring.

Weight scale equipment introduced into the herring fishery in Scotia Fundy Region (1985)

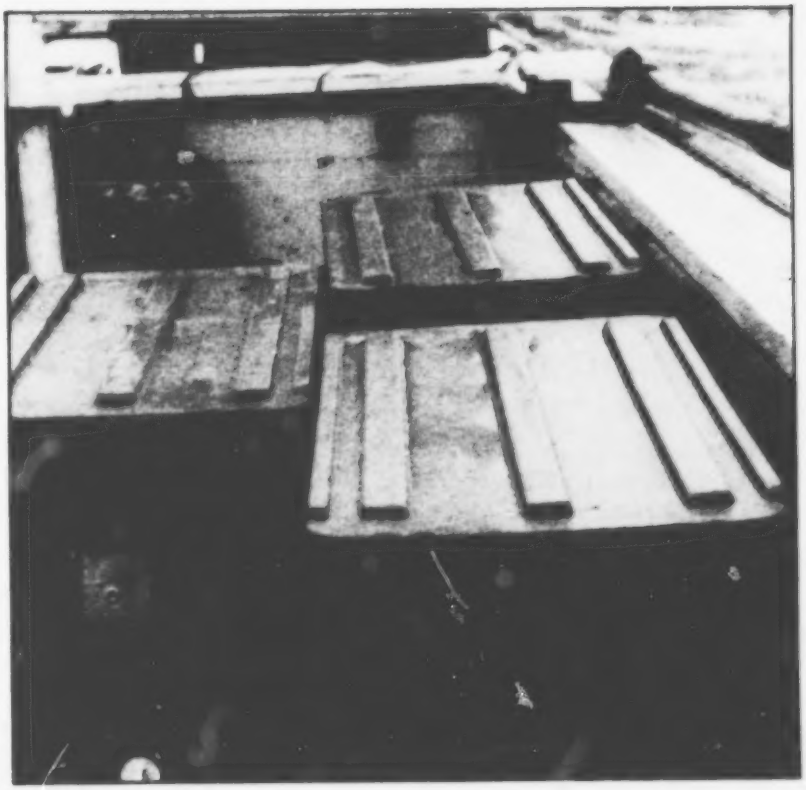
Insulated Mackerel Container

A project to explore the feasibility of improved handling of inshore mackerel using insulated containers was also initiated recently by the Gulf Region.

Inshore fishermen have always claimed that transferring mackerel from gillnets to containers is too clumsy and time consuming. Traditionally, tote boxes and ice have been used. Unfortunately, the tote box has never been able to produce high quality mackerel.

In this project, an inshore vessel was outfitted with 12 insulated containers, and results were monitored daily. The containers were medium sized, able to hold four to five hundred pounds of fish, and used up to half a ton of ice per day, depending on the size of catch.

Grading was done at dockside and the results showed much improvement in the quality of landed fish. When the fish reached the wharf, they were in a rigid state, very close to freezing temperature. As product quality grades are developed and processors begin to purchase fish using quality-based price differentials, quality will become a key factor in the selling of fish, hence the need for demonstration activities of this type.



Insulated containers full of iced mackerel – Gulf Region

Handling, Holding and Offloading Systems (Snow Crab)

In its continuing effort to help fishermen land catches in prime condition, Gulf Region, DFO has conducted several pilot projects during the 1984-85 period in the midshore snow crab fishery.

The CSW-RSW System (1984)

The purpose of the first project was to introduce the Circulated and Refrigerated Sea Water System (CSW-RSW) on board. Testing of the system was carried out on three small seiners from B.C. that had been purchased by Caraquet fishermen and adapted for east coast crab fishing. The three vessels were equipped with a system that could circulate sea water through holding facilities to cool it.

At the beginning of the fishing season, because the water temperature was sufficiently low, only the system which circulates sea water was required to operate. Water was pumped into the holds and overflow was expelled directly overboard. Once the surface water became too warm, the sea water refrigeration system was started up. With the RSW system, water circulates, but must be oxygenated by air pumped into the holds.

Despite a few minor adjustments during the season, the operation of the CSW-RSW system and its capacity to reduce the mortality rate of snow crab on board fishing vessels proved very satisfactory. The quality of the crab brought ashore by the three vessels was far superior to that usually obtained. In one instance, crab stowed for about six days was landed in Caraquet with a mortality and mutilation rate of less than 1 percent. A mortality rate of at least 10 per cent on landing is not uncommon when crab is improperly handled and stowed on traditional vessels.

The CSW-RSW System

However, since the CSW-RSW system is not suited to all vessels, DFO had to look at other options for the majority of the fleet, which hold their catch in bulk.

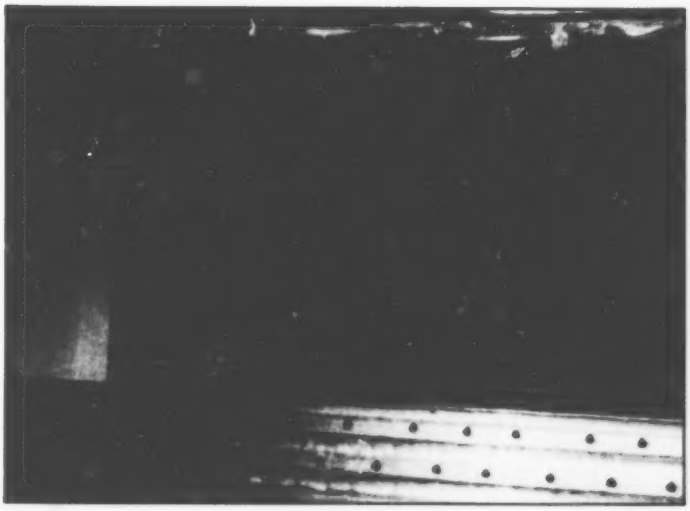
The Sea-Water Spray System

Gulf Region tested at sea during the fall of 1985 a sea-water spray system. This built upon a successful experiment conducted in Newfoundland in 1982-83. The objective: to increase the survival rate of crab stored in a hold unsuited for the CSW-RSW system.

To keep captured crab alive requires, ideally, that holding conditions be similar to those of its natural habitat. The sea-water spray system provides an alternative to CSW-RSW, but it also ensures an adequate supply of sea water and oxygen for the crab, thus keeping them alive longer.

The prototype system included three major elements: a pumping system, a refrigeration unit, and an oxygenation system. To these are added units for spraying, filtering, and collecting water in the hold, as well as for controlling operations. First, water is pumped from the sea surface. It then goes through a filter and the refrigeration unit, where its temperature is lowered to 0°C. Afterwards, it goes to the hold where it is sprayed on the crabs. The water cools them, supplies oxygen to the gills, and ends up in a water-collecting pan. At this stage, it is oxygenated and reintroduced into the pumping system, and the cycle continues. To ensure an adequate balance, oxygen content and pH, 10% of the water is replaced by new sea water at each cycle and the same quantity of used water is eliminated.

The equipment required to test the effectiveness of this system was installed and four trips were made during the experiment. The death rate was reduced significantly and this will allow fishermen to remain longer at sea when catches decrease. Both fishermen and processors have noted with interest the improvement in the quality of landed crab.



Spray system heads at the top of an onboard crab holding pen

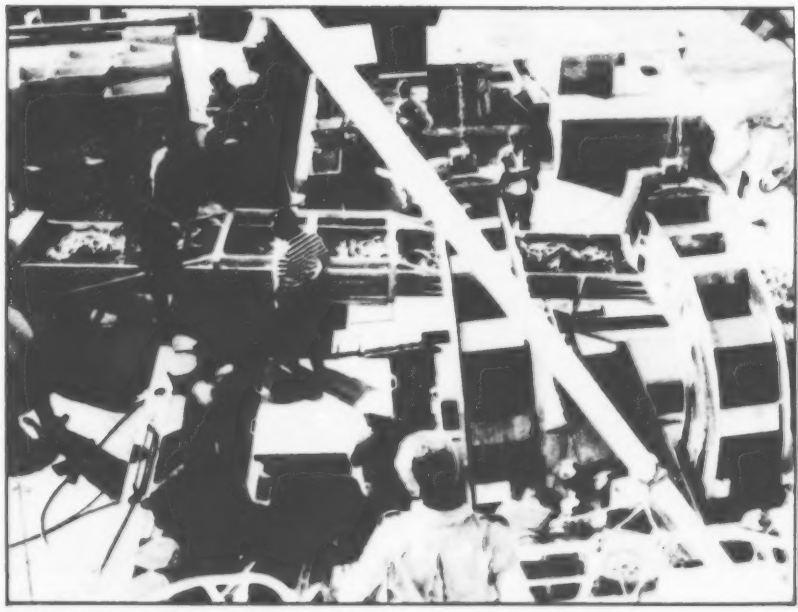
Crab being sprayed with refrigerated seawater in an onboard holding pen

Unloading System – Gulf Region

While these projects were being carried out, DFO was also testing a new unloading system which makes use of a conveyor especially designed for handling crab.

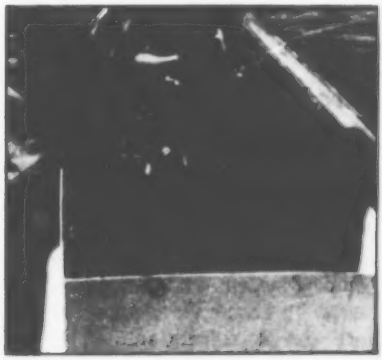
The new system can deliver approximately 15,000 pounds per hour (this includes the time needed for installing the conveyor and transporting crab to the trucks), or 5,000 pounds more than the traditional system, which involves lowering containers into the hold and bringing them up with a winch.

It is, however, impossible to determine the exact time needed for unloading because the system was on trial during the project and some adjustments had to be made during operations. Nonetheless, judging from the comments and the data obtained during that time, this system will be faster than the traditional one and, more importantly, will ensure better preservation of the crab.



Mechanical Crab Unloader on the MV *Keramatt* – Caraquett, N.B.

Live lobster in storage tank



On Board Storage of Lobster – Quebec

In assessing the conventional storage of lobster in wooden boxes and preserving live lobster in a seawater tank equipped with a circulation system, DFO has found that tanks have definite potential for improving the quality of product sold in the marketplace.

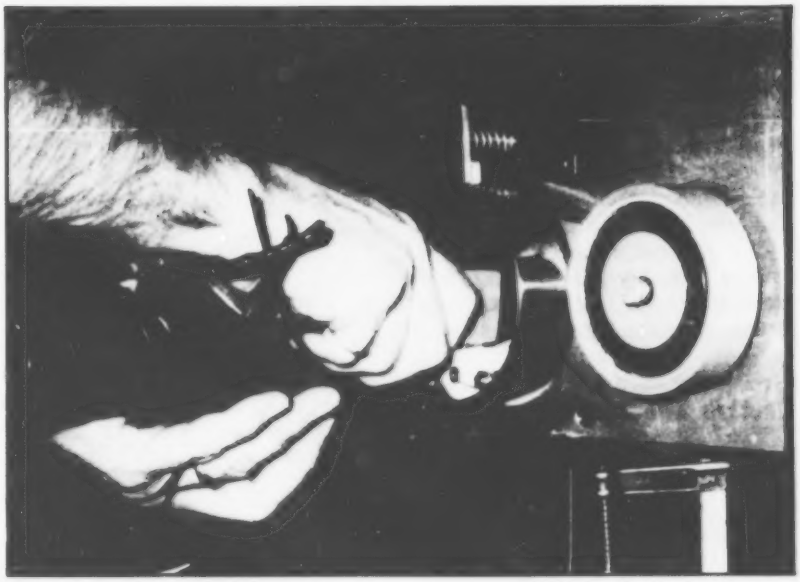
In recent project work in Quebec, the mortality rate recorded in a sample (386 lobsters) in a holding tank was zero from capture to unloading. After several hours of storage in a pound, a mortality rate of less than 2 per cent was noted. By contrast, the mortality rates for lobster stored in wooden boxes were 5.5 per cent and 7.3 per cent after 24 hours.

The strength and vitality of the lobster (movement of claws, for example) when removed from the tank were excellent, with no sign of weakening. In comparison, the lobster stored in wooden boxes showed little movement after unloading and some were dead.

Financial assistance has since been provided to Quebec fishermen to equip their vessels with these holding tanks. Response from fishermen has been enthusiastic and returns to both fishermen and processors have increased dramatically because 1) there is no weight loss in the lobster, and 2) returns are greater because of the improved condition of the lobster.

Lobster Claw Immobilization (Scotia-Fundy)

When lobsters are stored in pounds for extended periods, they lose the rubber bands traditionally used to immobilize their claws. When this happens, they injure one another, lowering their market value considerably, or worse, many die of infection. The suggestion was made that modern tapes be used instead, which would require a prototype tape applicator.



Tape Applicator – Lobster

Immobilized lobster

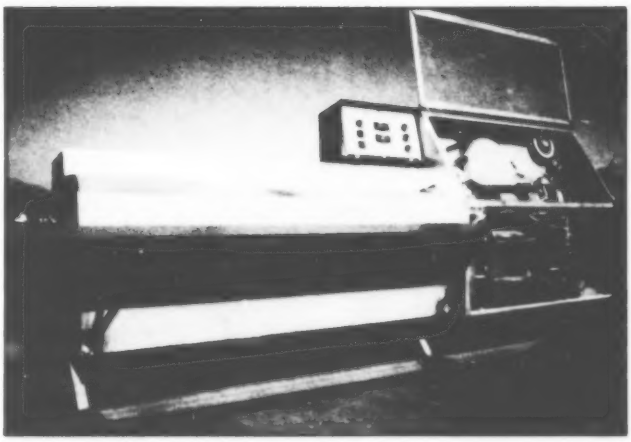
Four tape applicators for immobilizing lobster claws have, therefore, been designed and developed and have undergone limited field testing. The concept appears to be valid and has evoked interest in the industry. Technical staff from a Canadian tape manufacturer have also been involved in the project.

Evaluations to date have resulted in the conclusion that current prototypes, while promising, require further refinement. Work continues.

Scallop Shucking Machine

The development of a small portable scallop shucking machine suitable for onboard operation has been a continuing priority in Scotia-Fundy Region. This goal has resulted in the award of a Crown patent on a process that individually shucks sea scallops using a combination of saws and water jets. The patent has been "privatized" through a licencing arrangement between Canadian Patents and Development Limited and ABCO Industries Limited of Lunenburg.

The Mark 1 commercial prototype was manufactured and tested at sea aboard a 55-foot scallop vessel in 1983. These trials were somewhat disappointing in that only 50% of the scallops processed were completely eviscerated. Previous lab trials had achieved a successs rate in excess of 80%. The limitations and unreliability of the process have been fully documented and alternative means of evisceration, utilizing a separate machine, have been developed.



ABCO Automatic Scallop Shucker

Machine installed on a small 50 ft dragger in preparation for tests.

The revised system concept (MKII) would utilise a separate machine to remove all of the soft parts from the shell and deliver them to a separate, automatic eviscerator. The eviscerator then removes all of the undesirable portions,including the roe (when present) and the liver. This Axial Pinch Roller Eviscerator (A.P.R.E.), has been under development during 1985 and has been successfully demonstrated under laboratory conditions. If it can be operated at acceptable levels of performance, a complete system will be fabricated and evaluated at sea.

At the moment, the meat separator, utilizing the principles already perfected in the MK 1 version, has been fully designed, and 90% fabricated. But actual sea trials and production depend on successful lab trials. Meanwhile, Canadian Patents and Development Ltd. is making application to obtain a patent on the revised A.P.R.E. evisceration process.

With the steady recovery of the offshore sea scallop resource and increasing exploitation of the Iceland scallop, the MKII scallop shucker is certain to enjoy a steady market in Atlantic Canada, not to mention tremendous opportunities for foreign sales.

AFDP Studies

Quite often before, during or after doing something in fisheries-related R&D, there is a need to analyse the situation. The method used is "the study". Scotia-Fundy Region in recent months has been involved in several studies which have addressed quality enhancement through handling, holding and offloading:

Wetfish Stowage and Handling Study – existing and proposed alternatives to the traditional bulk method of stowing and handling fish were reviewed to create a compendium of information on the subject. The Contrawl, St. Pierre, French and European systems were included. The report made clear that containerization would prove valuable both for new vessels and for retro-fit applications.

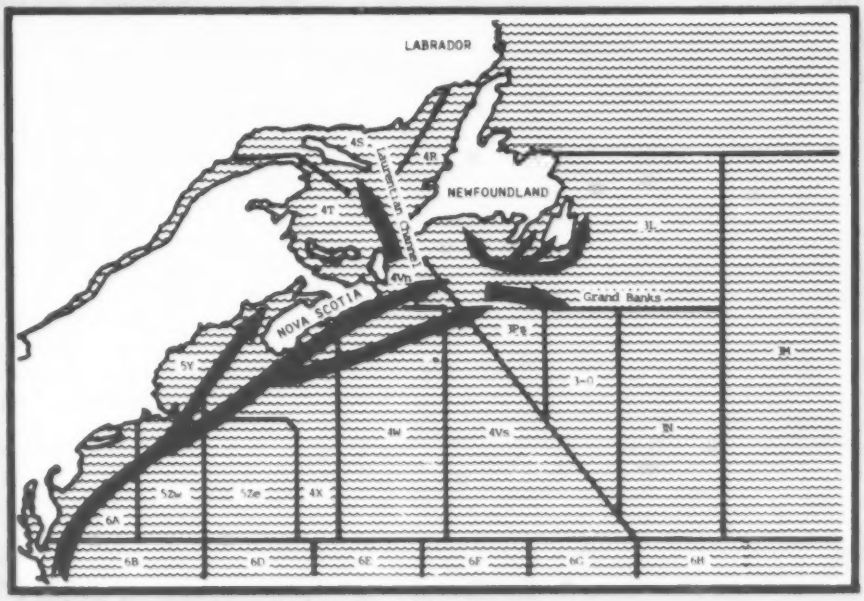
Onboard Fish Handling System for Offshore Wetfish Trawlers – this study developed an integrated onboard system which can be adopted to existing offshore wetfish trawlers. The system design is modular and hence can be built around existing system components piecemeal. Estimated at-sea productivity increases of 19 - 56% are possible through increased yields and higher quality products. Payback period would be one year.

Fishhold Insulation Survey – this survey was conducted to determine whether the open or closed systems of fishhold insulation have proven most effective. The open system provides cavities between exterior planking and insulation within the hull; the closed system sees these cavities filled with insulation and sealed. Both systems have been used extensively in Atlantic Canada and both present certain difficulties. Based on evidence to date neither method is clearly superior, but some very definite do's and don'ts concerning each system have been identified.

Comparative Evaluations of Shell, Block, Flake and Slush Ice – workability and ice quality changes were evaluated, and an analysis of advantages and limitations of each type was used to provide guidelines to fisherman on how to select the most effective and practical ice supply and facilities.

Evaluation of Fish Unloading Operations in the North Nova Area – this study was intended to establish the effect of mechanical unloaders on fish quality. It concluded that all vacuum unloaders impart measurable degrees of damage, with newer models contributing least to the problem. And, finally,

The Fresh Fish Quality Enhancement Project – S.W. New Brunswick – undertaken to identify harvesting, handling and preservation practices requiring upgrading in the Region, it recommends additional training, expansion of the "boxing at sea" concept and the development of a bleeding box/gutting table suitable for inshore vessels in the area.



Arrows show spring migration of spiny dogfish to Canadian waters.

Atlantic Spiny Dogfish

"A nuisance" is how Atlantic fishermen describe the spiny dogfish. Recently, however, they have begun to change their minds, having discovered that "the nuisance" is in demand as food by a number of countries. It is now beginning to be viewed as the largest underutilized finfish resource in the Northwest Atlantic.

In the western North Atlantic, the range of these fish extends from Holsteinsborg, Greenland south to Cape Lookout, North Carolina. Their wintering grounds are off the Carolinas and Virginia. The spring migration, as well as being prompted by water temperature, is probably also prompted by a search for a more abundant food supply available in the nutrient-rich waters off Nova Scotia and Newfoundland.

They arrive off Nova Scotia and in the Bay of Fundy in June. In July, they appear in the Gulf of St. Lawrence. In Newfoundland waters, they appear on St. Pierre Bank in June then move into bays on the south coast. Greatest concentrations are found in Placentia, St. Mary's and Fortune Bays.

Immature males and females, as well as some mature males, may winter in Newfoundland waters in deep channels and holes on St. Pierre Bank, in the Laurentian Channel, and in some of Newfoundland's south coast bays. Latest estimates by DFO indicate that the total biomass for all areas is in the 300 000 t. range.

Product Development

Product development (and product innovation) provide increased utilization of the resource and allow us to address the needs of a rapidly changing marketplace. Increasing yields from existing production and creating new and different products are two things which quite simply must happen for the industry to capitalize on the recent upturn. Development work here has been limited, but again, some advances have been made.

Dogfish

The "dogfish problem" in Scotia Fundy Region is causing difficulties of two types. First, fixed-gear cod and haddock landings were down considerably in 1985 compared to 1984 and previous years, and many fishermen claim that the severity of the dogfish infestation is directly related to the decrease in landings. Secondly, longline and handline operators are actually tying up vessels, rather than contend with dogfish. Fishermen's incomes and processing plant volumes are both negatively affected.

In the fall of 1985, the Region chartered two 45' draggers in Southwestern Nova Scotia to investigate the level of by-catch of commercial species in a directed dogfish fishery. The intention, ultimately, is to achieve a reduction in the existing dogfish biomass. However, this work must be repeated, in part, during the summer months, when dogfish are most plentiful, in order to validate results achieved.

At the same time, a combined processing and marketing investigation was conducted to evaluate the potential of the species. DFO contracted the Technical University of Nova Scotia to conduct dogfish storage stability tests and to make surimi from dogfish as well as a consultant to study all aspects of dogfish utilization. Although British consumers eat dogfish as "rock salmon", Belgians as "sea eel", and Germans as "schillerlocken" (smoked dogfish belly flaps), indications are that existing markets cannot absorb large additional quantities. New markets and/or new uses must be found to warrant a commercial fishery in Atlantic Canada or the existing stocks must be reduced by some other means. The consultant has prepared a comprehensive report, also incorporating the Pacific Coast, and this has recently been published by Scotia Fundy Region.

Dogfish being dumped from an otter trawl off Nova Scotia

Roe Capelin/Male Capelin Development — Newfoundland

The major market for Newfoundland capelin is Japan (whole, frozen, female capelin). Landings for 1985 were 33,500 t, yielding a production output of 13,500 t of whole, frozen capelin. This compares to landings of 41,000 t and production of 17,600 t in 1984.

The total value of the fishery was estimated at between $15 and $17 million in 1985, compared to $25 to $30 million in 1984. The average price paid to fishermen also declined from 10¢ per pound in 1984 to 7¢ per pound in 1985, but in 1986 the situation is expected to improve.

Capelin prices paid to fishermen depend on the female to male ratio, roe to body weight ratio and the quality of the females, i.e. the percentage of redfeed occurring in roe capelin. Fishermen usually attempt to identify these criteria on the fishing grounds by sampling catches pursed up alongside. However, "drying up" capelin often reduces the amount of oxygen available to the fish. This frequently leads to high mortality rates but is not a problem when the trapped capelin are suitable for market and taken onboard. However, when catches do not meet market specifications, the trapped fish (often dead) are released. This puts undue pressure on the resource.

In 1984, the Newfoundland Region developed a sampling tool and technique, which allowed crews to accurately determine the composition of capelin in the seine before subjecting the catch to pressure resulting from the pursing process. A weighted hoop net with a conical entrance was used to collect samples from various parts of the seine. This was done while the trapped fish continued to swim freely in the seine, thereby eliminating induced mortality in the catch. Sampling results thus improved seiner efficiency in that crews did not waste time drying up catches that did not meet market requirements.

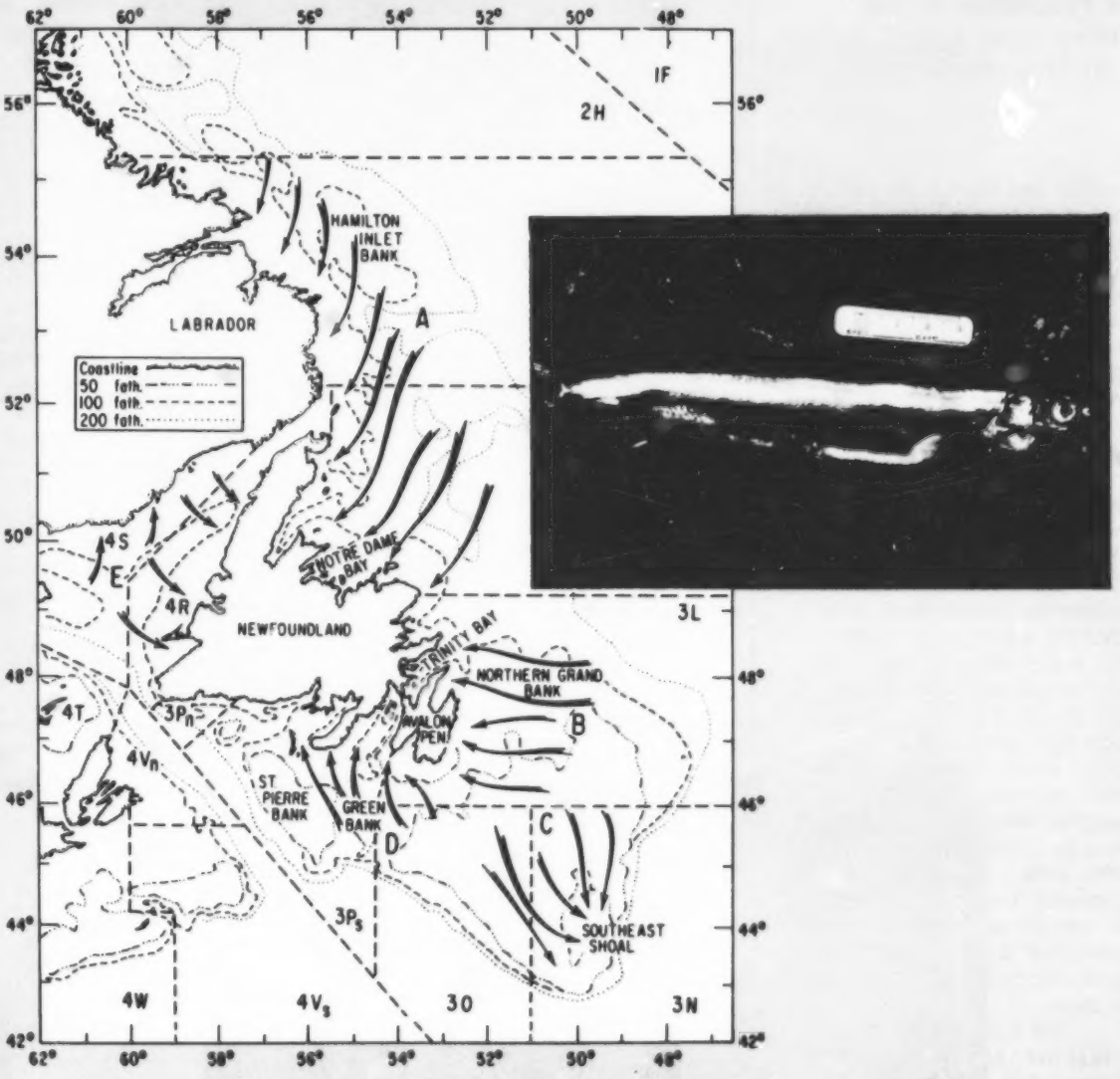
Although the inshore summer capelin fishery is a major contributor to the fishing industry, offshore stocks are left virtually untapped by Canadian interests. In 1984, the Soviet Union harvested capelin offshore and provided (at no cost) 200 metric tons to DFO for experimental purposes. In an effort to find a commercial use for them, supplies of frozen male capelin were then provided to a number of Atlantic-based processing companies for market testing and product development.

Since then, two agreements have been signed with private companies and an additional proposal is being evaluated. One company is currently developing a salted, dry-smoked capelin pub snack, and the other has proposed improvements to a canned product not currently considered marketable as well as the development of other capelin products. This work will be followed by extensive market testing.

Dressed Capelin ready for further processing

Canned Capelin

Capelin Smoked for packaging as pub snacks



This map shows the major stocks of capelin (labelled A-E) and their probable migration routes during the spawning migration. Other alpha-numeric designations are Northwest Atlantic Fisheries Organization (NAFO) statistical divisions.

Capelin

Capelin (or caplin), *Mallotus villosus*, are small silvery fish, close relatives of smelt. They are cold water, pelagic, schooling species inhabiting Arctic and sub-Arctic seas in the Atlantic and Pacific. On the east coast of North America, capelin appear from Hudson Bay to Nova Scotia but are most abundant around Newfoundland and Labrador.

There are five major stocks of capelin located near Newfoundland; (a) Labrador-Northeast Newfoundland stock; (b) Northern Grand Bank-Avalon stock; (c) South Grand Bank (Southeast Shoal) stock; (d) St. Pierre-Green Bank stock; (e) Gulf of St. Lawrence stock.

Pilot Project to Encourage the Production of Top Quality Light Salted Codfish — Newfoundland

The production of light salted codfish is unique to Newfoundland. It has been produced by inshore fishermen and their families for centuries as a "cottage industry". Production of this cure declined drastically in recent years, having given way to a heavy salted cure, which requires less effort on the part of fishermen. But, good quality light salted codfish is again in high demand in several European countries as well as the Caribbean and with ethnic groups in North America.

In an effort to increase production of this unique product, Newfoundland Region, in cooperation with Canadian Saltfish Corporation (C.S.C.) and the Federal Economic Development Co-ordinators' office, carried out a pilot project during 1985. It took place on Fogo Island, where several inshore fishermen retain the art of producing good quality light salted codfish.

Results of the project, although incomplete, were most encouraging, with considerable interest shown by inshore fishing crews. Further work is needed to determine its potential, however, i.e. to determine whether returns on the product are adequate to compensate fishermen for the extra effort involved in a light cure.

The C.S.C., in its plans for the next five years, is emphasizing the impact that an increase in light salted codfish production would have on the salt cod industry.

Fresh Cod, Split and Salted-Heavy Cure

Quebec Cod, dried using the traditional method undergoing inspection

Newfoundland light salted cod — Fogo Island Project

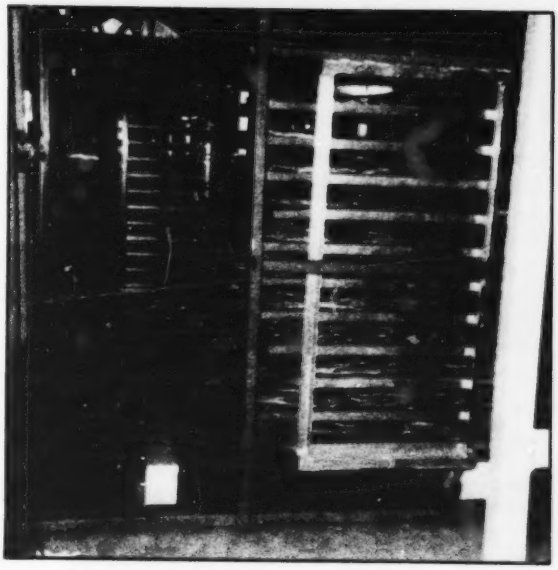
Evaluation of the "Gaspé Cure" Salted Cod – Quebec Region

This Quebec study was aimed primarily at rationalizing the treatment of "Gaspé Cure" dried salted cod, taking into account the contribution and possible applications of modern technology to the traditional procedures still in use. (drying in the open air).

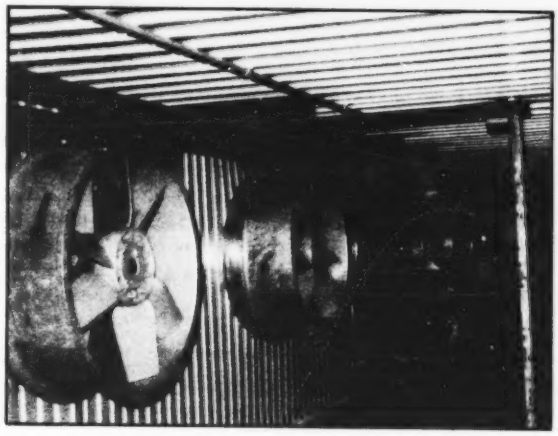
It has led to a precise definition of "Gaspé Cure" cod produced in Québec. It has been possible to determine precisely the balance of materials (water and salt), color, texture, and the role and nature of the microbiological flora specific to the "Gaspé Cure". This was required as the basis for the standardization of the finished product.

Attempts at using a mechanical dryer to ensure uniformity of the final product, however, and to minimize dependance on the weather were unsuccessful.

The detailed results of this work will be published in a formal paper in the near future and should provide some insight into how the Region might best proceed from here.



Mechanical Dryer – Quebec



CONSERVATION-ORIENTED HARVESTING*

Objective: To improve the utilization of Conservation-Oriented Harvesting Methods and Technology

to introduce and improve harvesting techniques which will reduce by-catch and mortality ratios, thereby enabling the industry to better target and maximize its catch within the approved resource management framework, and to promote the dispersion of fishing effort among species and gear types to ensure that incomes are maximized and stabilized over time.

In recent years, there has been a growing demand from the fishing industry and from marine biologists that fishing gear be developed that is less damaging to the resource and that is more selective. Bycatch is, of course, a perennial problem in trawls, seines, traps, etc. Certain other types of gear currently in use, scallop rakes for example, kill a high percentage of the species with which they come in contact, but do not harvest. Improving the efficiency and selectivity of fishing gear is the answer to this type of indirect exploitation.

Direct over-exploitation can also occur – the resource is not endless. We can and have fished given species to the point at which their ability to renew is brought into question. Licensing, restrictions and quotas notwithstanding, greater selectivity of fishing gear can be of assistance here, but fleet diversification and re-deployment may also, in certain instances, be required. Again, the job of testing and proving the available options has fallen to the Atlantic Fisheries Development Program.

*Gear Development/Fleet Diversification

Longline Development

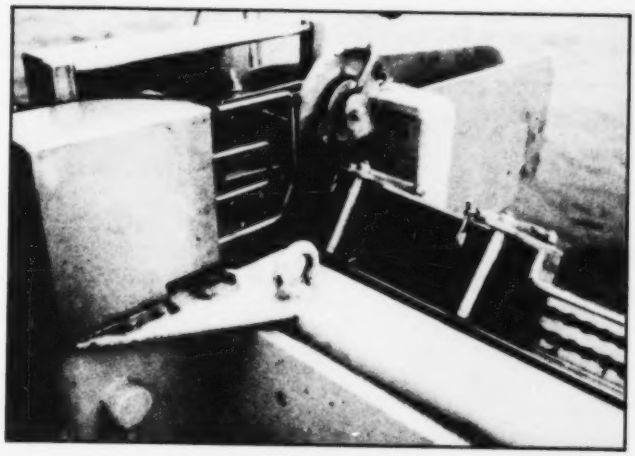
When Europeans started fishing off Canada's Atlantic coast five centuries ago, a single hook and line was their main method. Fishermen used single lines with hooks until the second half of the nineteenth century. Then many of them began to tie a series of hooks, by means of "snoods," onto a long "groundline" or "mainline" and longlining, often known as "setting trawl," became popular.

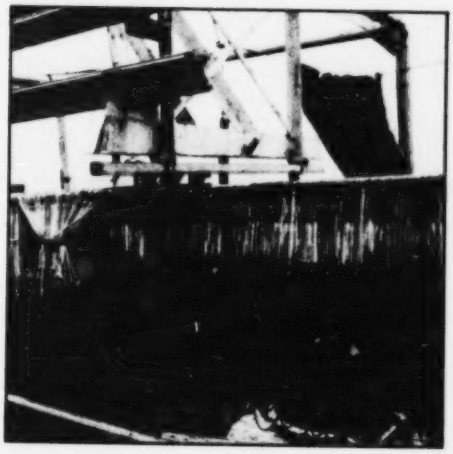
After World War II, many fishermen switched to gillnets, especially when synthetic materials made them more cost-effective. As fish became scarcer in the years before the 200-mile limit, gillnets did a better job of catching them than alternative methods.

But longlining has its own advantages: fish stay alive on the hook, rather than dying as they do in gillnets, and longlines tend to catch bigger fish.

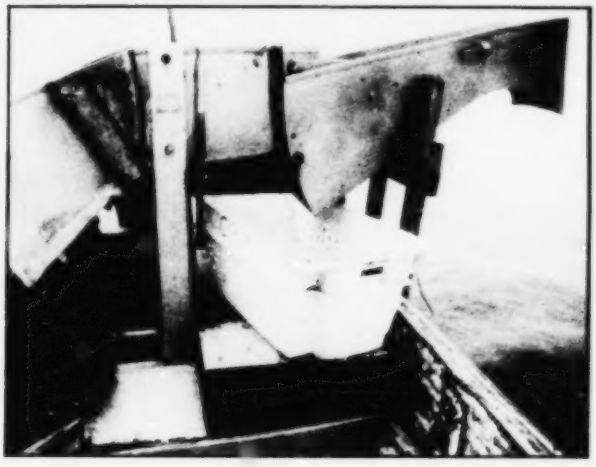
In the early 1970's, the Mustad company of Norway introduced the Autoline system. It used "precision baiting" – that is, it baited each hook individually. This system was introduced to Canada by Scotia Fundy technologists.

Mustad System including the horizontal magazine





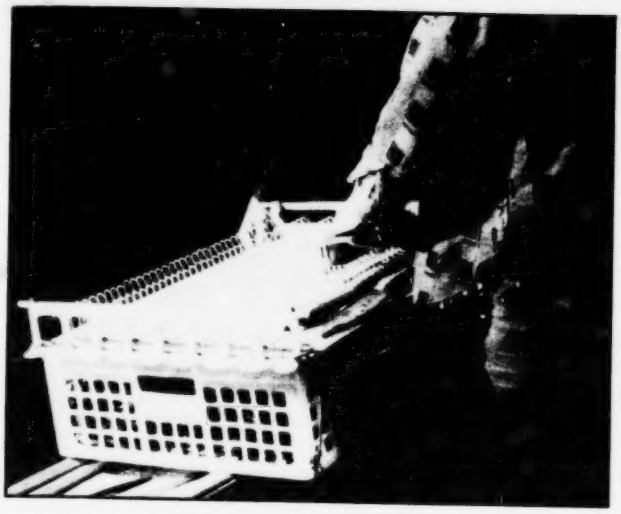
The Marco Matic



At about the same time, the Marco company of the United States (Washington) developed the Ty-liner. This system used "random baiting" – that is, it pulled hooks through a hopper of bait to snag pieces "at random".

But fishermen and small manufacturing companies, in the Faroe Islands and Canada particularly, began developing simpler, cheaper random baiting systems. Several types came on the market in the late 1970's and early 1980's. The Global System was developed in close cooperation with Scotia Fundy Region, and has been manufactured in Dartmouth, N.S. for several years.

The Nordco company, funded by the Newfoundland Region, developed a third type of baiter: the "Gangbaiter." Instead of dealing with one hook at a time, this method lines up many hooks alongside the bait fish, and twists the bait onto the hooks with a single motion. Another single motion cuts the bait fish into sections, leaving one piece of bait per hook.

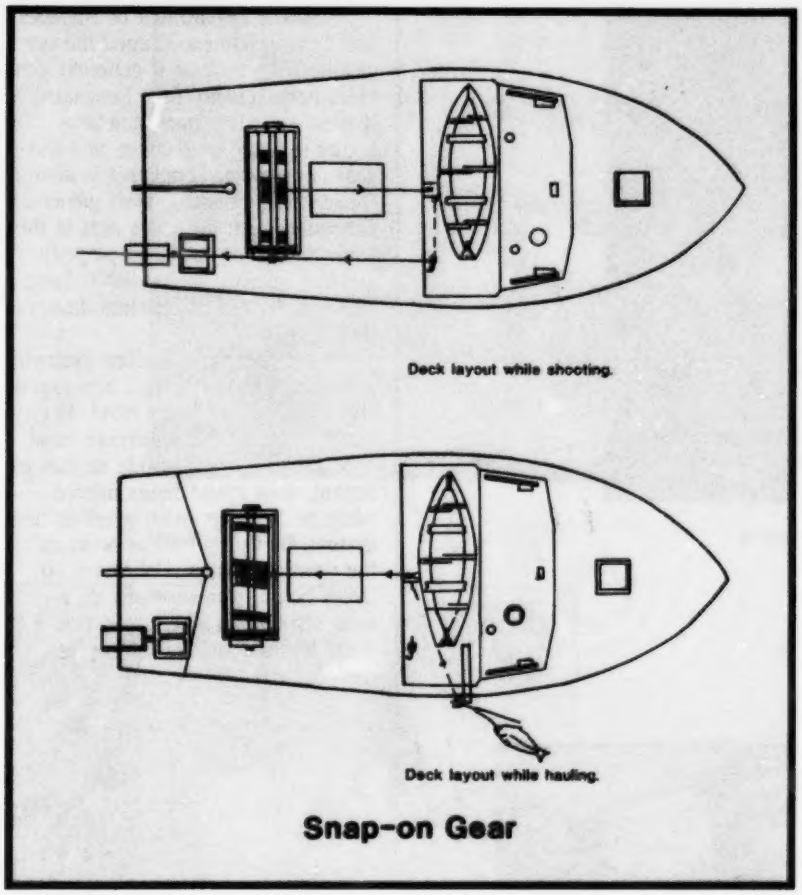


Nordco Gangbaiter System being tested by fishermen in "Gulf shore" Nova Scotia.

The Nordco system has come to predominate as an alternative to conventional manual baiting methods

The Department of Fisheries and Oceans has encouraged the use of longlining because it generally provides better quality fish. Longlining is more selective than gillnetting; it cuts fuel and boat costs; and the gear is compact. Longlining is also conservation-oriented. With gillnets, fishermen often put more nets in the water than they can tend properly and lost gillnets "ghost fish". Longlining eliminates this useless destruction of fish.

Self-baiting longline systems do away with the tedious and expensive work of baiting by hand. Normally, a small-boat fisherman must watch the weather, decide he can go fishing, then spend hours ashore while he baits up. With a self-baiting system, he can go out as soon as the weather breaks. Fishermen on larger boats, who normally do at least some baiting at sea, can instead let the machine "do it for them".



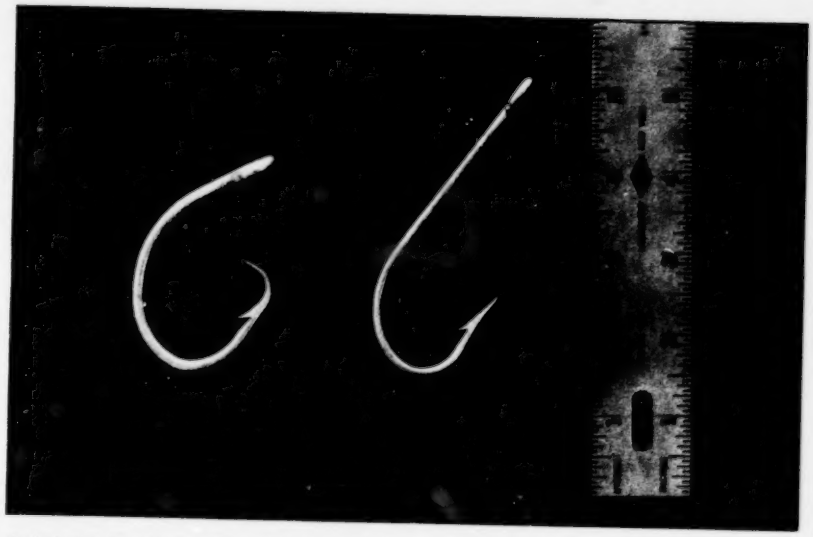
Snap-on Gear

The Snap-On Drum Longlining System for Halibut

Scotia-Fundy Region fishing trials demonstrated in April, 1983, that snap-on drum halibut fishing is feasible on Canada's east coast and has several advantages over conventional gear. Some of the advantages are: increased crew safety, more time for crew to attend to the catch, clearer deck space, hooks always freshly baited with preferred bait (to suit bottom conditions), and hooks randomly spaced, as desired. The crew as a result can handle more gear with greater ease, and can have more time to rest.

Snap-on gear differs from traditional gear in that the branch lines (gangions) are attached to the groundline with metal snaps rather than simply being tied. The groundline used for snap-on gear consists of skate length lines tied together to form one continuous line that is simply stored on a drum after the gangions are removed. Storing the line on a drum greatly reduces on deck storage space requirements. The buoy lines are hauled by a gurdy and stored separately for resetting. This ensures that proper lengths of buoy lines (to suit water depth) are used each time the gear is set.

Setting and hauling the line is simpler and safer, and because of this and other possible advantages, it was decided to test the gear on a commercial east coast halibut longliner, fishing out of Lockeport, Nova Scotia. In these tests, snap-on gear worked trouble-free and demonstrated all of the anticipated advantages.



A circle hook and a traditional longline hook

Circle Hook Comparison

In addition, circle hooks have been introduced to longline fishermen for cod, haddock and pollock with a high degree of success, but their application has been limited, due to the difficulty of handling them. Manufacturers were contacted, new designs suggested, and it is hoped modified circle hooks will be available for testing with these species again in 1986/87.

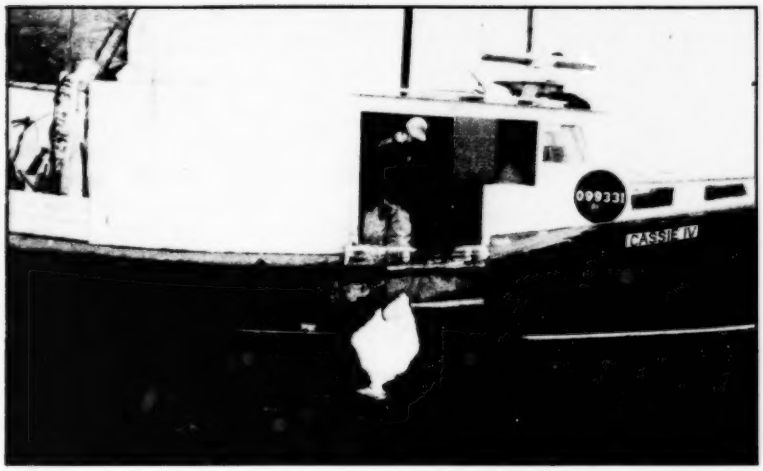
Meanwhile, they have also been evaluated for use in the halibut fishery. The comparison count of fish landed by both circle hooks and traditional hooks clearly indicated the superiority of circle hooks for halibut.

The radical design of circle hooks, with the point turned in towards the shank and their heavy gauge construction makes them almost maintenance free. The points rarely touch a rock or obstruction on the bottom and, therefore, the points do not become dull or broken. The hook is shaped to encircle even the largest jawbone for a secure catch rather than the lip catch often encountered with traditional hooks. Crew safety is also greatly improved; the inward-turned point tends not to catch flesh or clothing during shooting or hauling.

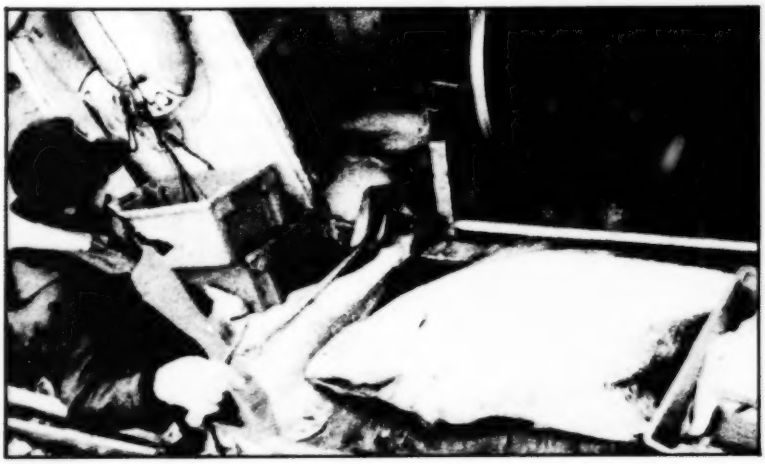
The only recognized drawback with the use of the circle hooks was the extra time required to bait. Bait must be put on and twisted over the point in a different manner than with traditional hooks, and this takes time to learn. After becoming familiar with circle hooks, fishermen require about 10 percent more time to bait properly, but this is not expected to deter their use.

Almost all Nova Scotian halibut longliners have now converted to circle hooks.

The "CASSIE IV"



Halibut Longline aboard the "Cassie IV" using the Snap-on Drum



Halibut Longlining – Western Newfoundland

A traditional fishery for halibut has existed along the West Coast of Newfoundland, prosecuted mainly by the soutwest coast longline fleet (50' – 65' class) and by dorymen who fish during the inshore migration of capelin.

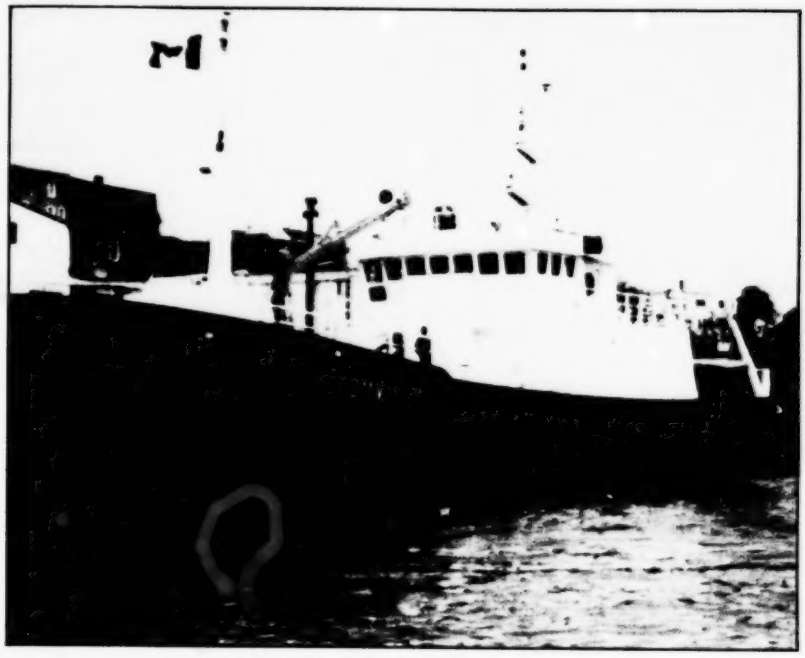
Effort, for various reasons, declined during the past 10 years and so Gulf Region initiated a project to introduce British Columbia Snap-On/Drum Longlining technology, proven earlier in Scotia Fundy, to the inshore fixed-gear sector in Newfoundland. The objective was to assist in the purchase of equipment and the training of crews to redirect effort away from the more traditional species such as cod and herring and to harvest halibut (by now under-exploited in the Region).

The main advantage of snap-on drum longlining over tub fishing was found to be in taking back the gear. Shooting time is equivalent for both gear types, but take-back time is reduced by approximately 50%, due to the ease of storing the groundline on the drum, lack of langks, and reduced storage time.

The secondary objective was to demonstrate circular halibut hooks, also proven earlier in Scotia-Fundy Region.

The standard No. 14 halibut hook was replaced with the No. 16 circular hook during the study. The hook performed to expectations. On no occasion were large halibut lost and they retained a substantial cod by-catch as well.

Halibut fishing using Snap-On Drum Longlining has the potential to become a viable supplementary fishery for the inshore longline fleet in the 35' – 50' class. Experimental



The Norwegian Autoliner, M/V "Keltic" (above) Offloading its catch of fresh cod (below)

fishing has demonstrated the potential for a supplementary inshore fishery timed to coincide with the spring capelin spawn. The major deterrent is the initial capital cost for a unit, but home-grown ingenuity will probably overcome this drawback. Fabrication of the gear in Newfoundland should reduce costs to manageable levels.

Middle Distance Longlining Project — Scandinavian Vessels

A significant factor influencing the viability of many Newfoundland inshore fishing enterprises, particularly vessels in the 44' – 65' range, is the short fishing season.

The objective of this project was to determine the viability of year-round longline fishing in the offshore sector (i.e. outside 12-miles) using middle-distance vessels. The M/V "KELTIC", over the course of the year in 1984, landed 3,123,581 lbs. (H.O.G.) of cod in 152 fishing days, realizing an average catch rate of 0.5 lb. per hook fished. This indicated a cod resource, fairly wide-spread in distribution, that would be available to larger inshore vessels from June to November each year. It was thus decided to underwrite bait and fuel costs for three inshore autoline vessels for commercial trips to the Virgin Rocks to determine the commercial potential for this type of vessel. The fishermen involved in the project eventually came to feel that, based on catch rates achieved, there is sound potential for greater effort in the area. In fact, increased numbers of inshore vessels operating there would be a prerequisite to any kind of comprehensive exploitation of groundfish stocks on this part of the Grand Banks.

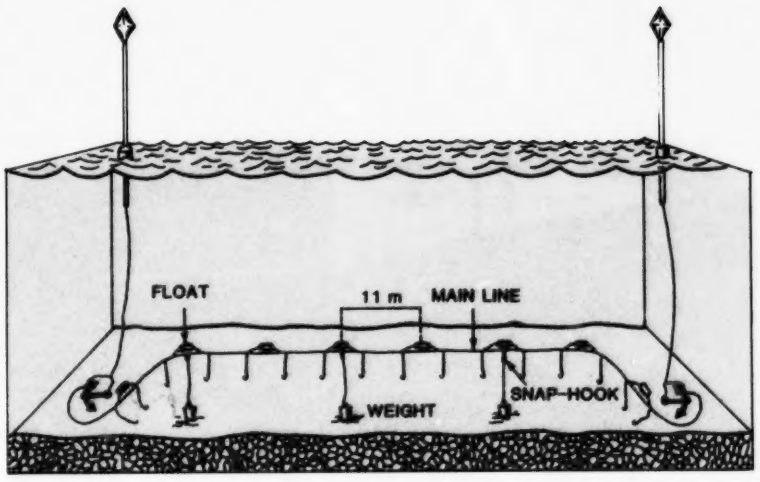
Suprabenthic Longlining (Midwater)

In the Quebec Region, a conventional bottom longline was converted into a suprabenthic longline by attaching a float every six fathoms and a weight of approximately 1.5 kg every 12 fathoms along the main line. In September, 1984, tests at sea were done in the Gaspé Region to compare this new longline with conventional gear.

Following numerous variations in the arrangement of the experimental gear – even though the tests were carried out during a period when fish were not abundant – interesting results developed. First, the average catch yields, based on the number of fish per hundred hooks, were approximately 108 per cent higher with the new gear. Secondly, catches were of a higher quality because once caught, the fish had no contact with bottom-dwelling predators.

In terms of total volume, catches increased by 80 per cent. However, the depth of the suspended hooks will need to be adjusted to increase the average length of fish caught. (Larger fish feed near the bottom – at 1/2 fathom).

Another interesting result of the study is the performance of the bait. During a series of immersions, the percentages of bait remaining on the hooks of a conventional longline after two and four hours of fishing are 15 per cent and 5 per cent respectively, while those of the suprabenthic longline were 65 per cent and 55 per cent – a definite increase in productivity. Finally, a substantial number of conventional hooks on the longline were replaced with circular hooks. The number of cod caught per hundred hooks increased by 115 per cent. These results, although preliminary, indicate that the performance of this type of longline is most encouraging.



In addition to limited "pure R & D" to improve longlining, DFO continues to provide technical advice and assistance to individual fishermen on equipment and methods to encourage them to switch to longlining and to improve efficiency and safety where longlining is already an established method. It is important here to stress the need for this type of activity, not only to continue, but to increase in scope, as resources permit.

Square and Diamond Mesh Comparisons

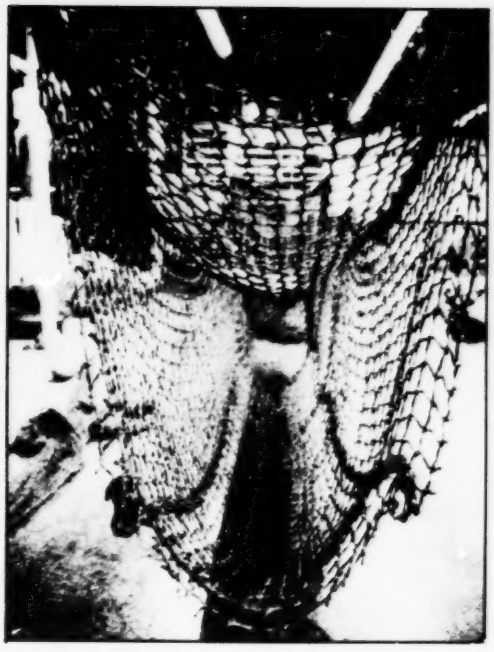
Preliminary trials carried out in 1982/83 (Scotia-Fundy) showed that square rather than diamond shaped meshes in codends reduced the catch of undersized fish and debris with no reduction in the quantity of marketable fish. In addition, there was less crushing of fish and, therefore, better landed quality; and, since meshes stayed open, the drag of the trawl and, therefore, vessel fuel consumption, was lower.

Trials were carried out in 1983/84 using a different trawl material (nylon) of larger diameter, but with the same vessel fishing in the same general areas. Using a 130mm mesh size codend, the number of small cod and haddock (less then 43cm), was reduced from approximately 13% to 2%. The usual debris – seaweed, sand, shells and gravel (in addition to unwanted species) – was not retained to any degree in the square mesh trawl. A clean catch of large fish resulted in a reduction in the work on deck; fish were processed and stowed quickly.

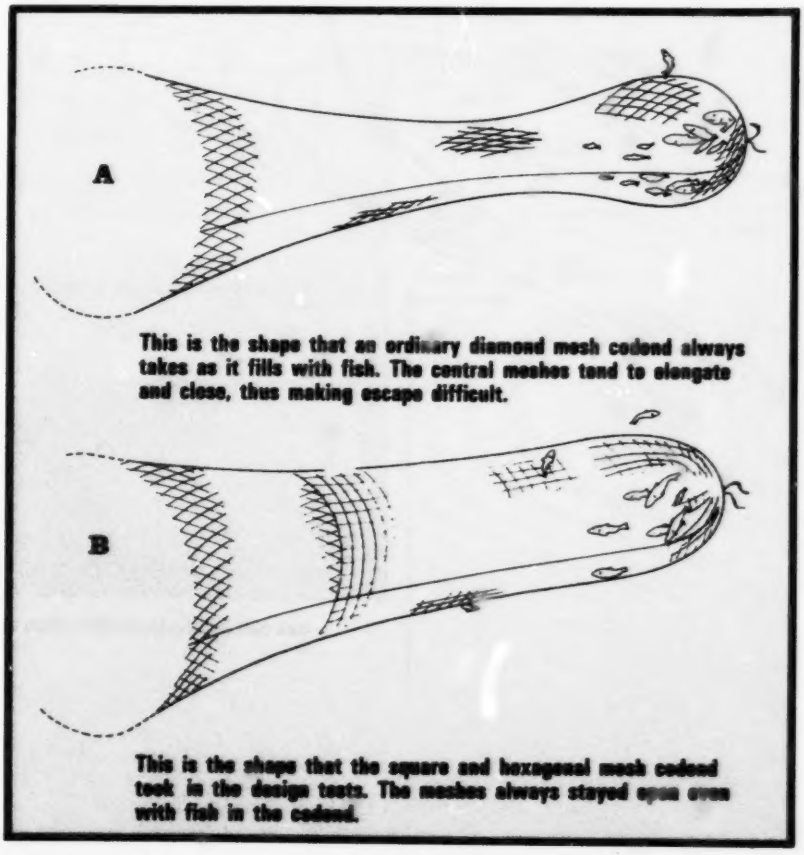
Trials using larger trawls on offshore vessels were carried out in 1984/85. A high-priority project, this experiment had many objectives, all of which were achieved. They were:

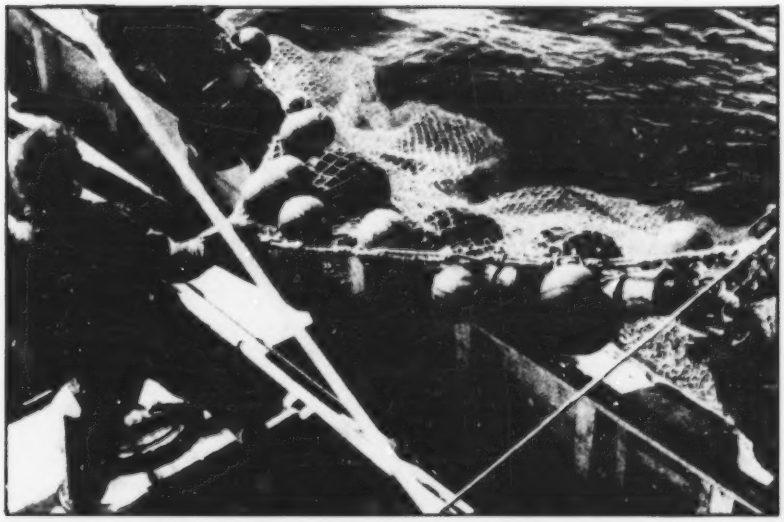
- to improve the landed quality of the catch;
- to increase the efficiency of the method;
- to permit the escape of immature fish and unwanted species;
- and to eliminate debris (and thus alleviate the sorting problem).

Experimentation was carried out on research vessels and by commercial charter of a 65'. fishing vessel. Data were collected from a total of 80 replicate stations; 54 completed by the research vessels and 26 comparative tows completed by the commercial vessel.

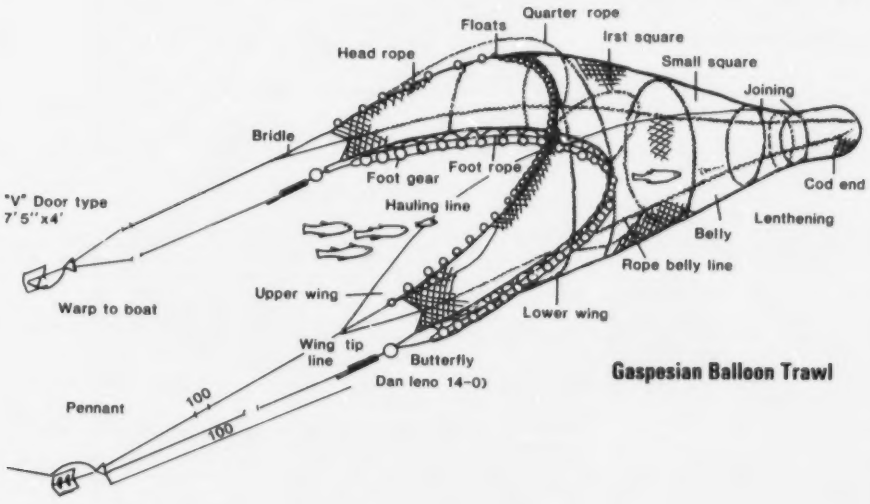


Square mesh codend


A
This is the shape that an ordinary diamond mesh codend always takes as it fills with fish. The central meshes tend to elongate and close, thus making escape difficult.
B
This is the shape that the square and hexagonal mesh codend took in the design tests. The meshes always stayed open even with fish in the codend.



The Yankee 36 Trawl – note wooden footgear and rubber tire bobbins.



Gaspesian Balloon Trawl

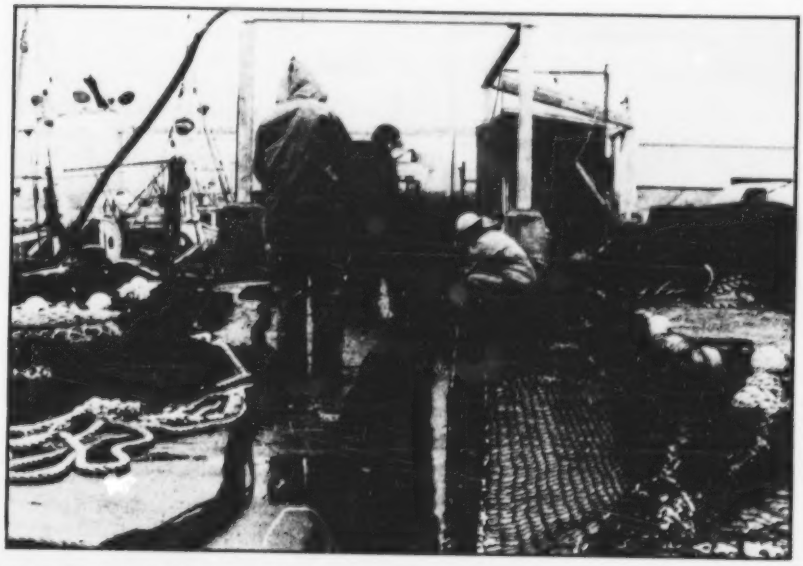
Codends used during the experiments were constructed of 5-1/8'' (130mm) mesh and the square mesh condend, as expected, retained fewer small fish in comparison to diamond mesh.

Balloon Trawl – Cod

The cod fishing grounds on the south coast of Gaspé are very rough and a lot of gear is damaged and/or lost there every year. Fishing time lost in gear repair is also substantial. The ''Yankee 36'' trawl has been fished there over the years using wooden footgear and rubber tire bobbins. The amount of drag (resistance) inherent in gear of this type is substantial and an obvious candidate for development work aimed at reducing it.

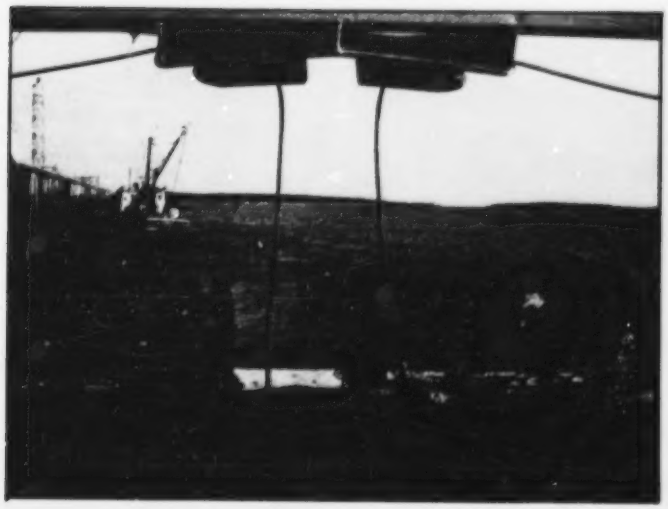
The major component of a test rig designed for the Québec Region is rock hopper footgear, described earlier. It was combined in this experiment with a modified balloon trawl. Rubber rings were also used all along the net's lower bridles to reduce wear and tear.

Preliminary results indicated equivalent efficiency of the trawl, compared to the conventional gear, with less gear damage. But because the net must be fished using a side trawler, modifications must be made to the wings, square and bellies before widespread utilization. Fishermen have already recognized the potential of the new trawl, however, and, after its modification, it will be readily adopted.

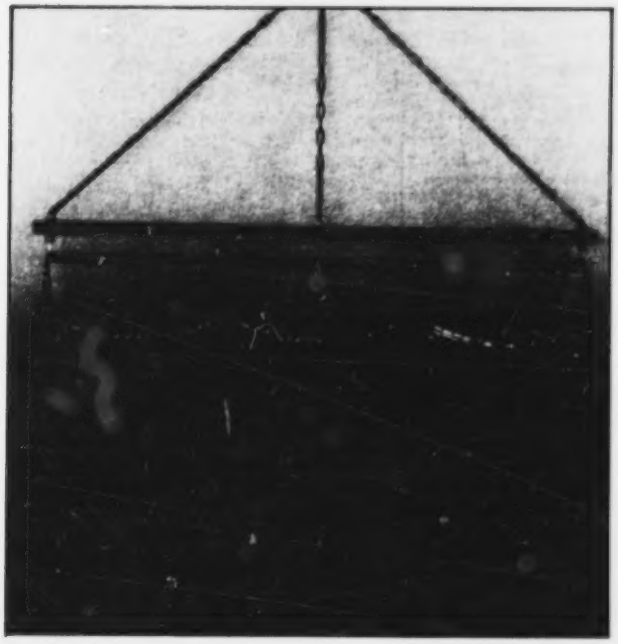


A Balloon Trawl being assembled on a wharf in the Gaspé.

Balloon Trawls will be fished in the Gaspé area using side trawlers like this one – "The Merrimac".



Digby versus Cayenne Scallop Rake



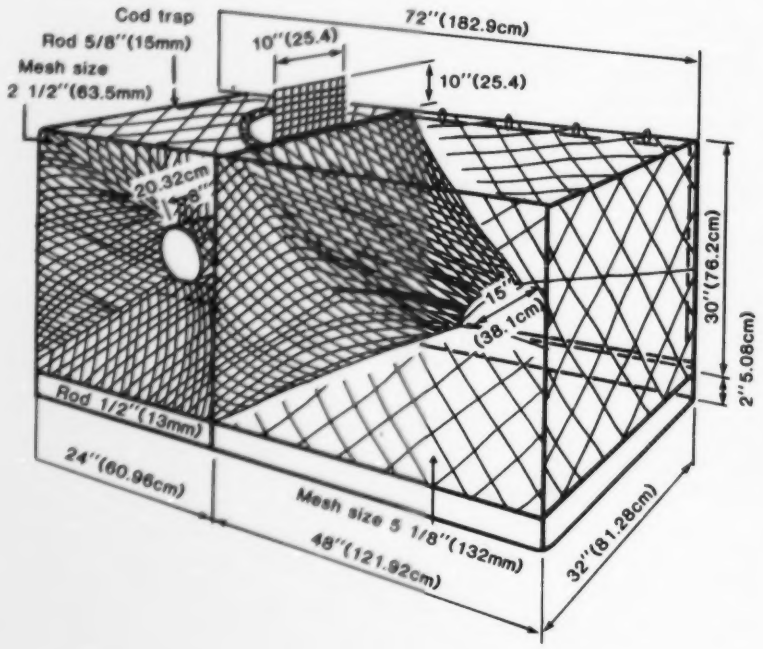
Inshore Scallop Rake – The Cayenne

The "Cayenne" Scallop Rake

The Digby Scallop Rake has been the one used over the years by Québec fishermen. Like most traditional rakes, it has very definite weaknesses – it is not very selective, it causes high mortality rates in uncaught scallops and it damages the ocean bottom where scallops must reproduce.

It was therefore decided to attempt to develop an alternative rake for the Québec Inshore Scallop Fishery. A prototype was designed, constructed, and tested this past season. The main difference between the two types of rake is a chain framework which replaces the traditional steel mechanism. And after two weeks of comparative sea trials on the Québec North Shore, the new rake demonstrated equivalent or superior efficiency, but, most importantly, has shown superior selectivity – a higher percentage of market sized scallops is harvested – and there is a marked reduction in the amount of debris accumulated in the basket (i.e. rocks, dead shells, etc.). This reduces the sorting effort for the crew. Commercial application is planned for the Magdalene Islands during 1986 which will include minor refinements to the rake to further improve its selective capacity.

Cod Pot–Concept



Cod Pot Project

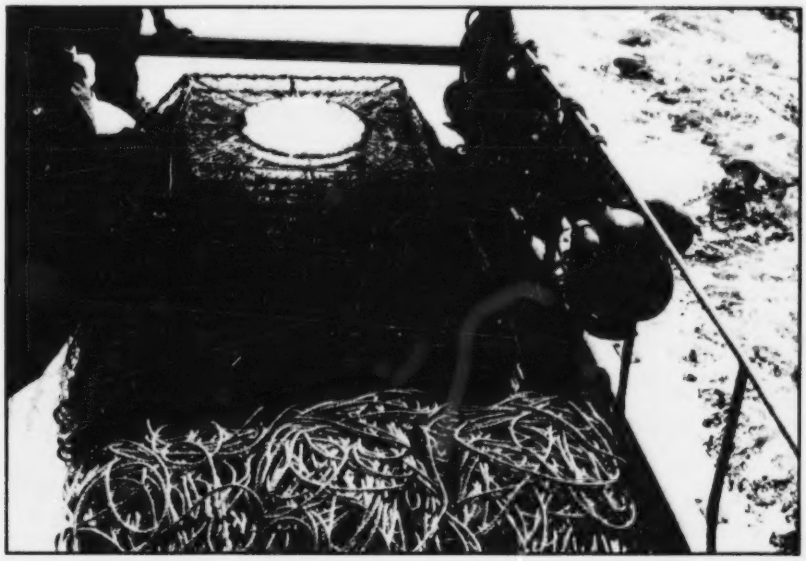
For a long time, in the Gulf Region and abroad, quality problems associated with the inshore groundfish fleet have been recognized mainly as a function of the gillnet fishery.

In light of this, and based on an incidental catch of cod in lobster pots, the Region experimented in the early 1980's with preliminary designs for cod pots. By 1985, in New Brunswick and Prince Edward Island, trials had been carried out at sea under commercial conditions (in collaboration with inshore fishermen).

In New Brunswick, the selected fisherman operated with 125 cod pots, while 2 fishermen on P.E.I. used 35 pots each. Small trials were carried out, as well, in Cape Breton.

Unfortunately, overall inshore groundfish landings were low for most of the 1985 season. This did not permit complete evaluation of the pots. However, on good fishing days, landings were comparable to those made by gillnets. More importantly, quality of landed product was very much improved; fish were landed in less time using less fuel; and fishermen had more time to devote to other tasks.

There is still much information which remains to be gathered on pot selectivity and equivalency, bycatch evaluation, mesh size, etc., before technologists will be in a position to make recommendations to fishermen. However, considerable interest is already being shown and many applications for licenses have been received. But for now, it is much too early to address the permit issue. Technical experimentation under commercial conditions will continue throughout 1986 and it is hoped that we will have more complete information at that time.



The Nordic Crab Pot

New Snow Crab Pot (Nordic)

Quebec fishermen have traditionally used mainly two types of crab trap. The conventional rectangular trap, is heavy, difficult to handle and takes up a lot of space on a vessel's deck. The second, the Japanese trap, is lightweight and stackable but, less sturdy. Now, there is a third option, the Nordic Trap.

The effectiveness of this new pyramidal trap, which has a 1.65-metre base, was established in 1984 when it was evaluated against the rectangular trap. The new trap will give higher commercial yields under conditions where crab are scarce, but superior selectivity is its chief advantage. In trials by the Quebec Region, the "Nordic" caught 25% more commercial size crab; 11% less non-commercial size crab; half as many soft shell (post molting) crab; and one third the number of female crab (these are too small for market and are needed to help renew the stocks).

Another positive aspect is handling; here the "Nordic" offers great advantage. Inshore fishing fleets must make many trips in order to catch geographically dispersed crab populations. At present, each fleet makes as many as four trips of up to 200km to move all of its traps. The Nordic is stackable; more can be carried each trip (and this provides important savings in fuel costs), and the ease with which it can be emptied, in comparison to the standard rectangular trap, is important. In addition, unloading is faster and less dangerous in bad weather.

Commercial trials in 1985 have proven its harvesting efficiency, energy savings and ease of handling. The Nordic trap is perhaps the ideal piece of gear for sheltered crab fishing areas located on sea beds with strong currents.

SPECIAL DEVELOPMENT PROGRAMS/SERVICES

Introduction

Atlantic Fisheries Development Branch (AFDB) in Ottawa is responsible for coordinating the Special Development Programs delivered through DFO's regional offices.

These programs cover a broad spectrum of activities including, among others, the construction of bait, ice and handling facilities, resource development projects, aquaculture, technological improvements to fisheries equipment and job creation in the fishing industry. They generate a pronounced socio-economic impact: they potentially benefit 52,000 fishermen and 47,000 plant workers in a fishery with a total landed value of $565 million and market value of $2 billion annually.

... when planning and analysis, research and development, and technology transfer work has been completed, much remains to be done. To the extent that all of this in itself is not enough, bolstering it with "special programs" is often required.

As we indicated earlier in this Report, when planning and analysis, reasearch and development, and technology transfer work has been completed, much remains to be done. To the extent that all of this in itself is not enough, bolstering it with "special programs" is often required. In fact, the degree of adaptation required by a modern fishery requires that certain pre-conditions be met. It is essential that basic infrastructure be provided to make it possible for the fishing industry to evolve. Special Development Programs, then, provide these pre-conditions to evolution.

Atlantic Fisheries Special Development Programs

PROGRAM	GULF	SCOTIA-FUNDY	QUEBEC	NEWFOUN-DLAND
Special Recovery Capital Projects Program (SRCPP)	x	x	x	
Atlantic Fisheries Ice-Making Infrastructure Program (AFIP)	x	x	x	
Southeast N.B. Dev. Agreement	x			
Fisheries Sub-Agreement (ERDA) – New Brunswick	x	x		
Fisheries Sub-Agreement (ERDA) – Nova Scotia	x	x		
Fisheries Sub-Agreement (ERDA) – Prince Edward Island	x			
Coastal Labrador Fisheries Development Program				x
Quebec Regional Fund – Gaspé and Lower St. Lawrence			x	
Quebec Regional Fund - Remainder of Quebec			x	
Terminated Programs 1984/85				
U.I. Job Creation Program	x	x	x	x
New Employment Expansion and Development (NEED)	x	x	x	x
Fisheries Resource Employment Development for Youth (FREDY)	x	x	x	x
International Youth Year (IYY) 85/86	x	x	x	x
Job Development Program (JDP) 85/86	x	x	x	x

Special Programs – SRCPP to JDP

1. *SPECIAL RECOVERY CAPITAL PROJECTS PROGRAM (SRCPP)*
This temporary program (1983/84-1985/86) to enhance the fishing industry's productivity and competitiveness has six components to provide various types of facilities depending on community needs.

   i) ***Ice-Making and Storage Facilities***: Ice shortages directly effect the quality of fish and can result in lower economic returns to the industry. The SRCPP program provides funds to build ice facilities of various types:

   - ***Silos*** include ice-making equipment from 12-30 metric tonnes/day with ice reserves varying from 30-50 metric tonnes, depending on the location.
   - ***Ice-Making and Storage Facilities*** are buildings with an ice-making machine, an ice storage room and in some cases a "chill-room" for the temporary storage of fish. These facilities range in size from 5-100 t.
   - ***Ice Reserves*** are small buildings or prefabricated units that look like modified aluminium shipping containers. They have an ice-making capacity of 6 metric tonnes/day and 15 metric tonnes of reserve ice.

   Ice may be produced in different forms and sold in quantities that range from 50 pound bags to metric tonnes depending on the needs of

   ii) ***Bait Service Facilities***: Buildings with equipment to freeze, store and sell bait or refrigerated trucks to collect, distribute and sell bait to fishermen.

   iii) ***Salting Facilities***: Buildings where local fishermen can split and salt their catch.

   iv) ***Fish Unloading and Handling Systems***: The equipment to unload fish from boats and put it in containers for transportation is critical to maintaining quality. (Ice shortages, pitchforking fish and exposure to the elements cause spoilage.) Components of the system include: hoppers, sorting tables, de-icing tanks, containers, A-Frames and jibcranes. Some unloading sites also sell ice.

   v) ***Industrial Water and Power Supplies***: The installation of water pumps, wells and power lines is a prerequisite in some cases before ice-making equipment can be installed. This initiative also provided adequate quantities of DFO approved water to fish processing and holding establishments.

   vi) ***Marine Service Centres***: These provide repair and gear storage facilities to increase vessel life spans and to help decrease operating costs to fishermen.

2. *ATLANTIC FISHERIES ICE-MAKING/STORAGE INFRASTRUCTURE PROGRAM (AFIP)*
AFIP was approved June 12/84 to provide ice-making and storage facilities,(as described under the SRCPP section), in approximately 100 communities throughout Quebec and the Atlantic provinces. AFIP assists operators through contributions or capital assistance of up to 80% of the cost of all facilities. The program is temporary, with all facilities to be installed between 1984/85 and 1985/86. Funds and human resources to be brought to bear in 1986/87-1988/89, inclusive, pertain to infrastructure planning.

3. *SOUTHEAST NEW BRUNSWICK DEVELOPMENT AGREEMENT*
This five year agreement of $2.7 million terminates in March 1986. It was geared to provide much needed improvement to product quality in the industry. Upgrading of fish plants to meet inspection standards enabled processors (bloater processors in particular)* to develop modern facilities; other key elements to the agreement involved the installation of ice-making and unloading facilities.

4. *CANADA – NEW BRUNSWICK SUBSIDIARY AGREEMENT ON FISHERIES DEVELOPMENT*
Signed on August 27/84 with an expiry date of March 31/89, the value of this agreement is $45 million (of which $25 million will come from the federal government and $20 million from the province). $10 million is earmarked for specific projects and $10 million is in loans.
The Canada – New Brunswick Subsidiary Agreement contains the following components:

   - *RESOURCE DEVELOPMENT*
     1. Salmonid Culture Program
     2. Mollusc Development
     3. Habitat Enhancement
   - *HARVESTING*
     1. Upgrading of Fish Holds
     2. Vessel Conversion & Refrigeration
     3. Middle Distance Groundfish Fleet Improvements
   - *FISHERY ADJUSTMENT*
     1. Commercial Salmon Licence Buy-Back Program
     2. Herring Seiner Buy-Back Program

*Hard-cured, smoked herring.

- *INFRASTRUCTURE*
  1. Ice-Making and Storage Facilities
  2. Mini-Marine Service Centres
  3. Unloading & Transportation Systems
  4. Bait Storage Facilities
  5. Shipyard Modernization
- *PROCESSING & PRODUCT DIVERSIFICATION*
  1. Product Diversification & Development
  2. Upgrading of Processing Plants
- *NATIVE FISHERY DEVELOPMENT*
- *RESEARCH, PROGRAM MANAGEMENT OPERATION, TRAINING, & INFORMATION*

5. *CANADA – NOVA SCOTIA FISHERIES SUBSIDIARY AGREEMENT*
Signed on October 26/84, with an expiry date of Mar. 31/89, the value of this agreement is $50 million with the federal government contributing $35 million and the province $15 million. Although the agreement was signed in 1984, authorization of the resources did not come through until August 20, 1985. During that time, discussions took place with the Province on how funds should be allocated initially. These discussions led to the two-phased approach shown below.*

The components of the agreement between the governments of Canada and Nova Scotia include:
Phase I

- *QUALITY ENHANCEMENT*
  1. Infrastructure Support
  2. Vessel Upgrading
  3. In-Plant Quality Control
- *EFFICIENCY IMPROVEMENT*
  1. Harvesting Cost Reduction
  2. Processing Cost Reduction
  3. Harbour Infrastructure
- *MARKET DEVELOPMENT*
  1. Seafood Promotion in Nova Scotia
  2. Product Development
- *RESOURCE ENHANCEMENT*
  1. Aquaculture & Inland Fisheries Development
  2. Under-Utilized Species Development
  3. Salmon Buy-Back
- *PUBLIC INFORMATION, EVALUATION & ADMINISTRATION*

6. *CANADA – PRINCE EDWARD ISLAND SUBSIDIARY AGREEMENT ON FISHERIES DEVELOPMENT*
Signed June 13/84 and due to expire March 31/89, the value of this agreement is $10.0 million with $7.5 million from the federal government and $2.5 million from the province.

The components include:

- *RESOURCE DEVELOPMENT*
  1. Oyster Development
  2. Quahaug Development
  3. Mussel Development
  4. Salmonid Rearing
  5. Natural Shellfish Holding
  6. Lobster Handling Improvement
- *HARVESTING*
  1. Longline Development/ Demonstration
  2. Onboard Handling Facilities
  3. Gear Development
  4. Energy Conservation
- *INFRASTRUCTURE*
  1. Fish Handling Systems
  2. Ice-Making/Storage Facilities
- *INDUSTRIAL DEVELOPMENT PILOT PROJECTS*
  1. Product Development
  2. Productivity Improvement
  3. Marketing Programs
- *INFORMATION/ IMPLEMENTATION*

7. *CANADA FISHERIES DEVELOPMENT PROGRAM FOR COASTAL LABRADOR*
Announced June 18/81 and expiring Mar. 31/87, this program provides financial aid to increase efficiency in the harvesting, landing, processing and storage of fish and includes the following types of activities:

- *Ice-Making and Storage*: construction, upgrading and supply of ice-making equipment and icehouses, as well as provision of chipping equipment to acquire natural ice.
- *Fish Holding and Cold Storage*: to address the need for increased or upgraded holding and cold storage capacity for both bait and fish along the coast.
- *Community Stages and Unloading Facilities*: upgrading and/or construction of community stages and dockside unloading facilities to provide improved working/ storage space and sanitary working conditions for the primary processing by fishermen of both fresh and salt fish products.
- *Utility Servicing*: installation/ upgrading of utilities to supply either fresh or salt water and electricity in order to operate pumps, lights and refrigeration equipment.
- *Fish Processing and Handling*: upgrading, expansion and construction of processing plants and the installation of refrigeration equipment.
- *Vessel Servicing*: facilities to accommodate the haulout, maintenance and storage of fishing vessels, as well as related services.

*Phase II will follow a review by the federal and provincial governments (to be completed prior to April 1, 1987).

8. *CANADA ECONOMIC DEVELOPMENT PLAN FOR GASPE AND LOWER ST. LAWRENCE*
Approved by Cabinet on May 5/83 and expiring Mar. 31/88, it is part of a strategic approach to fully develop the Quebec fishery and integrate it into the industry mainstream in Atlantic Canada. This initiative contains the following elements:

- *RESOURCE DEVELOPMENT*: to make optimum use of existing and potential resources and to foster introduction of new products with known development and marketing potential.
- *IMPROVEMENTS TO FISHING METHODS*: to improve landed fish quality by offering financial assistance to fishermen to modify vessels and equipment. Financial assistance is also given to fishermen for projects that reduce operating costs by attaining higher productivity.
- *TECHNOLOGICAL TRANSFER*: to develop and demonstrate new and/or improved methods of fishing; methods of handling fish on-board vessels; and new vessels.
- *REJUVENATION OF THE FISHING FLEET*: to provide financial assistance to restructure and rationalize the fleet and to build a prototype vessel.
- *PROCESSING*: projects to tailor fish plant production to market trends and conditions.
- *PLANNING & TECHNICAL STUDIES*: to maximize the impact of various projects through feasibility studies, information distribution and consultation initiatives.

9. *FISHERIES DEVELOPMENT PROGRAM FOR QUEBEC*
Approved on June 28/83 and expiring Mar. 31/88, it focuses on the following regions: Magdalen Islands, the North Shore and Northern Quebec. Its components are as follows:

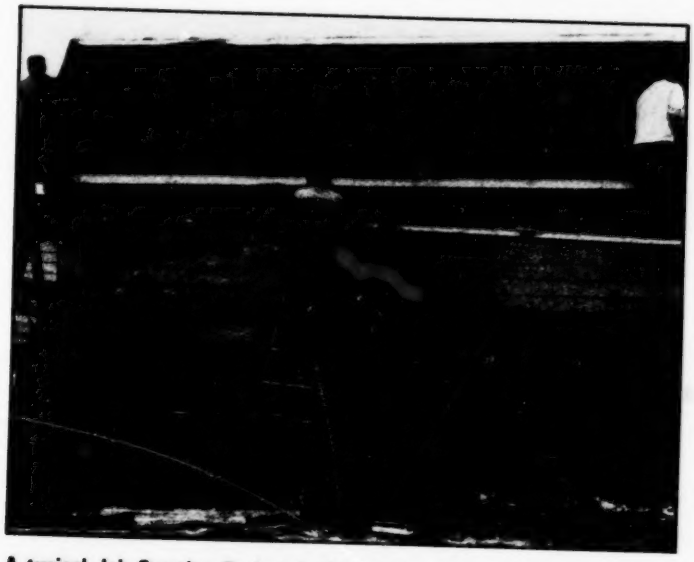
- *RESOURCE DEVELOPMENT*:
  a) to evaluate and identify new resource availability; and
  b) to research and develop improved harvesting/handling methods for new species.
- *HARVESTING & FLEET IMPROVEMENT*:
  a) to assist in development of new/improved catching and handling methods;
  b) to modernize the fishing fleet; and
  c) to develop a prototype coastal fishing vessel for the North Shore and Magdalen Islands.
- *FISH PROCESSING ASSISTANCE*:
  a) to install cooling systems and equipment thus improving cold storage efficiency;
  b) the development of methods/processes to ensure maximum yield by species; and
  c) to ensure that processing plants meet all Federal and Provincial regulations, as well as industry requirements.
- *NORTHERN QUEBEC*:
  a) identification and evaluation of the type and extent of resources available;
  b) development of resources for the economic benefit of Inuit and Cree who derive their livelihood from the fisheries sector;
  c) resource management to ensure continuing availability of the resource; and
  d) improvement of techniques and equipment to enhance processing and storage for subsistence-level fishing.
- *PLANNING*: technical studies, engineering plans, etc. to facilitate implementation of projects.
- *PROGRAM DELIVERY*: administration and management.

Job Creation

In 1982, the Department of Fisheries and Oceans opted to participate in national job creation programs in the fishing industry.

Projects to provide the unemployed with opportunities to use their skills were developed from suggestions by communities, organizations and DFO staff in the Regions and at Headquarters. These projects were intended to enhance the industry throughout the Atlantic Provinces and Quebec in: fisheries management, infrastructure construction/upgrading, habitat management, salmon enhancement, quality improvement and aquaculture.

The Atlantic Fisheries Service (AFS) accounted for the creation of approximately 7,500 jobs through various programs, (Section 38, NEED and FREDY, see below). With AFDB coordination, AFS implemented projects rapidly and contributed to the economic benefit of many fishing communities. These programs provided an excellent opportunity for the Atlantic Fisheries Service to take an active part in projects which otherwise would not have existed because of budgetary constraints.



A typical Job Creation Project is the construction of this bait freezing/holding facility in Meteghan, Nova Scotia (1983–84). Another is this salmonid enhancement project at Noel Paul's Brook, Newfoundland.

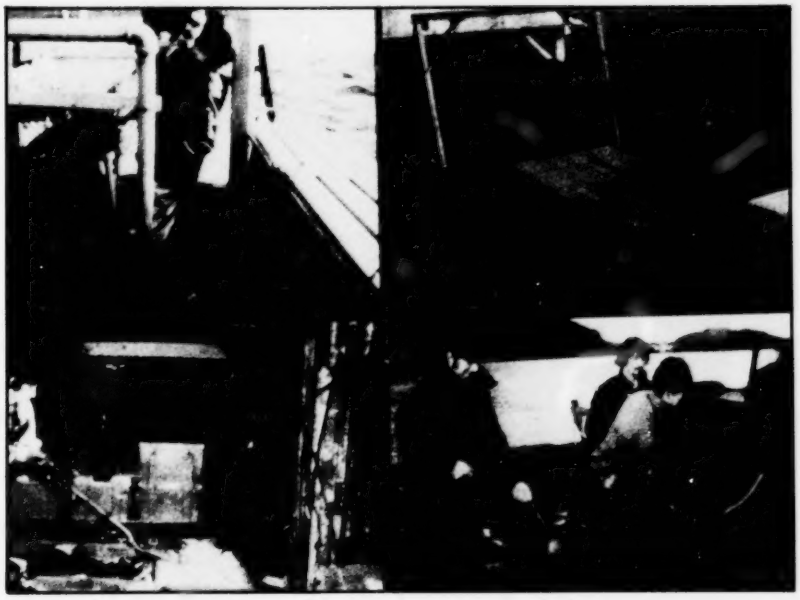
10. ***SECTION 38 – U.I. JOB CREATION PROGRAM***
This program was aimed at employing people eligible for unemployment insurance and began in 82/83. By the time it had terminated in 83/84, 3,900 jobs had been created for a total of 51,000 work weeks.

11. ***NEW EMPLOYMENT EXPANSION AND DEVELOPMENT (NEED)***
NEED was aimed at employing individuals who had exhausted their unemployment insurance benefits and ran from 82/83-84/85. NEED created 2,200 jobs for a total of 35,000 work weeks.

12. ***FISHERIES RESOURCE EMPLOYMENT DEVELOPMENT FOR YOUTH (FREDY) PROGRAM***
FREDY employed youth between the ages of 15-24, began in 1984 and terminated March 31, 1985. The Atlantic Provinces were allocated $6.8 million. Approximately 1,380 jobs or 19,932 work weeks were created by the Department.

13. ***INTERNATIONAL YOUTH YEAR (IYY)***
For participation in the observance of International Youth Year, the Department was allocated $0.5 million by the Minister of State (Youth) to implement projects that would be totally youth oriented, highly visible, and that would contribute to the conservation and management of Canada's renewable aquatic resources. Projects will be administered by the 12 DFO regional offices. AFDB was allocated $40,000 per region for a total of $160,000 in 1985/86. As of September, 85, 34 jobs had been created for a total of 210 work weeks.

14. *JOB DEVELOPMENT PROGRAM (JDP)*
The Department is currently participating in a number of job development initiations under the new Labour Market Strategy. The intent is to carry out fisheries – related work under a program which combines relevant skills-training and related work experience and which is designed to improve the employability and earnings of long-term unemployed individuals. Canada Employment and Immigration (CEIC) has indicated that allocations for projects in the fisheries sector in Atlantic Canada would be in the order of $6 million in 1985/86. DFO has thus far submitted 40 projects to CEIC (13 approved/27 pending) for approximately 293 jobs or 8,250 work weeks.

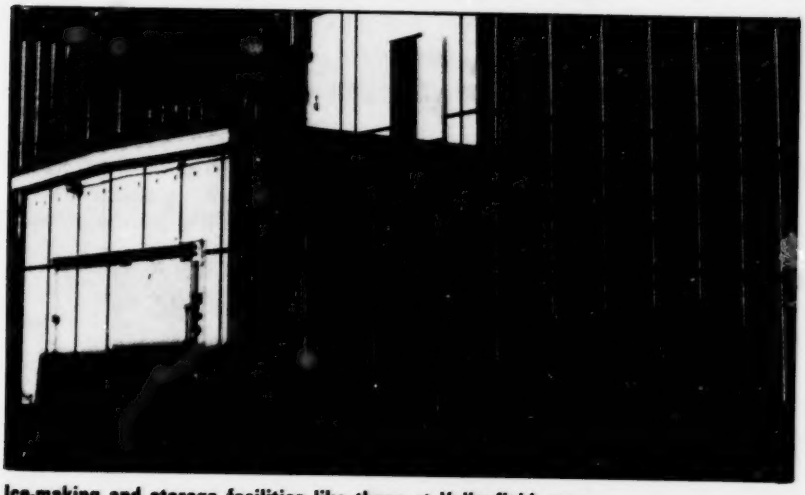


Special Services

Special Services expend in excess of $8 million/year providing bait products, fish unloading services, new infrastructure and job creation initiatives throughout Newfoundland and Labrador. Special Services include the Newfoundland Bait Program, the Inshore Fish Handling Program, and a Special Response Unit that operates a variety of programs which enhance facilities throughout the province.

The Bait Depot at St. Mary's is one of forty-five depots and units currently in operation by the Newfoundland Bait Service which provides an adequate supply of bait fish for the inshore fishery.

Net Bag Off-Loading System — Newfoundland Region



Ice-making and storage facilities like these at Valleyfield were established throughout Newfoundland by the Special Response Unit to meet the requirements of the inshore fishery.

The Newfoundland Bait Service ensures a continuous supply of fishing bait to commercial fishermen throughout the province. The service operates bait depots and bait holding units which freeze and store bait and sell it to fishermen as needed. The service purchases most of its bait fish locally, thereby providing many of the province's fishermen with an additional source of much-needed income.

The Bait Depot at St. Mary's is one of forty-five depots and units currently in operation by the Newfoundland Bait Service which provides an adequate supply of bait fish for the inshore fishery.

The Inshore Fish Handling Program (IFHP) is one of the main elements of the Quality Improvement Program. The IFHP operates off-loading systems and associated equipment in approximately 160 communities in the Newfoundland Region. It has been instrumental in improving the traditional fish handling practices of fishermen and fish processors and has been influential in improving fish handling practices throughout Atlantic Canada.

Since completing the installation of equipment, DFO has continued to operate and maintain off-loading hoists, A-frames and wash-down systems. Net bags and insulated containers which were developed in conjunction with the program, have proven successful and are now the responsibility of fishermen and industry.

The *Special Response Unit* determines community needs for new fisheries facilities and services, and plans and arranges for the maintenance and repair of existing facilities and services. The Unit also co-ordinates the planning and implementation of fishery related programs and projects jointly funded by DFO and other agencies such as CEIC. Major areas of involvement include bait depot and bait holding unit repair and replacement, fish offloading systems, quality enhancement work and salmon enhancement projects.

A Final Word

Fisheries-related research and development can be a frustrating business! To the uninitiated observer the failure rate for technological innovations can appear spectacularly high. Even when a new concept proves technically viable, it can run into difficulty when evaluated using economic, social or political criteria. An existing technology itself can also prove to be a barrier to innovation because of the difficulty in, sometimes, establishing effective interface between old and new equipment. The fact that most apparent "dead ends" can point the way to future success and make an invaluable contribution to a growing body of scientific and technical data too often goes unrecognized, unacknowledged or both. Even the seasoned R & D practicioner, schooled as he is in the frustrations of the discipline, can come to develop at best a cautious optimism toward the "high risk – uncertain returns" inherent in technological innovation.

Fisheries-related research and development can be a frustrating business. . . . The fact that most apparent "dead ends" can point the way to future success and make an invaluable contribution to a growing body of scientific and technical data too often goes unrecognized, unacknowledged or both.

In the end, the challenge is clear: to map out the overall strategy and then, very selectively, decide where and to what extent to get involved. Much progress has been made towards making the Atlantic Fisheries Development Program more focused and more oriented towards solving the fundamental problems of the fishery. But much remains. It is apparent, however, that to be effective, we should not spread our resources too thin. As we said earlier,

the art of fisheries development is to choose the points of greatest impact and optimize the allocation of scarce resources so that the really important work gets done. But the Atlantic Fishing Development Program cannot solve every problem for everybody. It is, therefore, essential that we strike an appropriate balance among:

- R&D to develop new technology for the future versus transferring technology already available.
- publishing purely technical data versus giving our clients basic information on which to make decisions,
- addressing local crises versus working toward long term, fundamental change,
- assisting the inshore harvesting sector versus work on the offshore fleet,
- a comprehensive approach involving harvesting and processing versus a more selective approach focusing on, for example, the inshore fleet only, and
- addressing localized issues versus Region-wide problems.

There is no simple or general formula for determining this balance and the appropriate admixture will vary from area to area and time to time. The best approach probably lies in continuing to refine the structure and approach now in place – it provides for regional variation as well as inter-regional co-ordination. Recognizing and understanding these competing forces is the first step towards ensuring a balanced and effective development program.

Special Programs/Services

Responsibilities and workload under Special Development Programs/Services have increased steadily in recent years and this increase is expected to continue for the following reasons:

- Special Programs are highly flexible, can be implemented more quickly than other types of initiatives and can target a specific portion of the industry or geographical location;
- Special Programs often embody the sensitivity of the relationship between the Department and the industry: needs are indentified on an ongoing basis in an ever-changing sector; and
- Special Programs, being temporary, reflect the current government's philosophy of helping out initially, but with a view to setting the private sector on its feet in the long-term.

Finally, and in addition to the Special Development Programs, DFO has provided, as we have shown, a variety of Special Services in Newfoundland and Labrador. The need for bait, unloading facilities, new infrastructure and job creation initiatives is unlikely to decline. Special Services will, therefore, be an ongoing requirement which will continue to be met under the Atlantic Fisheries Development Program.

Full Circle to the Future

The bottom line, however, is that the future viability of the Atlantic fishing industry will not be guaranteed by increased quantities of fish, but by the development and introduction of improved methods and technology:

- to Expand and Diversify the Commercially Harvestable Resource Base;
- to Reduce the Cost of Harvesting, Processing, Handling and Storage of Fish and Fish Products;
- to Enhance the Value of the Commercially Harvestable Resource through Quality Improvement and Product Development Initiatives; and
- to Increase the Utilization of Conservation-Oriented Harvesting Methods and Technology.

In the end, we will leave it to you, the reader, to judge whether or not the Atlantic Fisheries Development Program has achieved fundamental change, whether it has helped create a proper environment for development, and whether or not the necessary incentives are in place to ensure that improvement occurs. Do the pieces come together? Have the proper dynamics been set in motion? Have there been concrete results? We would like to think so.

Those involved in the Program have mapped out an overall strategy and then, selectively, in line with the resources available, have gotten on with the business of fisheries development. Their work must be evaluated accordingly. The objective throughout . . . successful people-oriented, profit-oriented fisheries technology. The vision . . . a modern, competitive, world-class fishing industry. As we look to the future, 1986/87 promises to be just as challenging!

New Directions in Fisheries Technology

Proceedings of the Atlantic Fisheries Technology Conference Charlottetown, Prince Edward Island, April 22–24, 1985

Edited by James F. Roache

This publication contains the proceedings of the Atlantic Fisheries Technology Conference, held in Charlottetown, Prince Edward Island, April 22–24, 1985. The first conference of its kind held in more than ten years, it brought together delegates from the primary and secondary sectors of the industry and from both levels of government, federal and provincial. Speakers from Norway, Denmark, Scotland, England, the United States and, of course, Canada made presentations covering a wide spectrum of current and anticipated technological developments in the fishery worldwide. Three separate working sessions concentrated on fishing gear and equipment, the onboard handling and holding of fish, and inplant operations, respectively. But scientists and technologists were not the only groups to be heard. Several "non-technical" presentations were made by representatives of both government and industry, including an address by an inshore fisherman from Caraquet, New Brunswick on the evolving role of the modern fisherman. However, the impact of innovative technology on the industry's overall efforts to improve quality and reduce costs predominates throughout.

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Director, Resource Allocation and
Development Branch
Department of Fisheries and Oceans
Moncton, New Brunswick

Andrew Duthie
Technology Program Coordinator
Atlantic Fisheries Development Branch
Ottawa, Ontario

APPENDIX C

CONTACT LIST – AFDP

For further information on the projects described in this report, please contact:

Fisheries Development Branch
Department of Fisheries and Oceans
Newfoundland Region
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

(709) 722-4438

Fisheries Development Branch
Department of Fisheries and Oceans
Scotia-Fundy Region
P.O. Box 550
Halifax, Nova Scotia
B3J 2S7

(902) 426-8110

Fisheries Development Branch
Department of Fisheries and Oceans
Gulf Region
P.O. Box 5030
Moncton, New Brunswick
E1C 9B6

(506) 857-7783

Fisheries Development Branch
Department of Fisheries and Oceans
Quebec Region
P.O. Box 15,5000
901 Cap Diamant
Quebec City, Quebec
G1K 7Y7

(418) 648-3817

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APPENDIX D

RECENT PUBLICATIONS AFDB HEADQUARTERS, OTTAWA

1. Roache, J.F. (Ed.). 1986. New Directions in Fisheries Technology. Can. Spec. Publ. Fish. Aquat, Sci. 86: 125p.
2. The Energy File (Harvesting), A Report on The Canadian Fisheries Energy Conservation/Cost Reduction Workshop, General Education Series, #1, Fisheries and Oceans, Ottawa, 1986.
3. An Atlantic Fisherman's Guide to Longlining Systems by the Technical Longline Working Group, Fisheries and Oceans, Ottawa, 1984.
4. Fisheries Education and Training in Atlantic Canada, General Education Series, #3, Fisheries and Oceans, Ottawa, 1986.

FISHERIES DEVELOPMENT BRANCH NEWFOUNDLAND REGION 1973-1985

1. Duthie, A. 1973. The Capelin Story.
2. Duthie, A. 1973. Interim Program Report Atlantic Capelin.
3. Brothers, G. 1973. The Capelin Ring Net Technique.
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PROJECT REPORTS

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